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JULY 1st 1954

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OUR COVER PICTURE

Our cover picture reproduces the results obtained from the face of a tricolour cathode ray tube during a recent demonstration in London of all-electronic, fully compatible colour TV. Colour blocks by courtesy of Messrs. Amalgamated Wireless (A'sia) Ltd., Wellington.

For full story see Editorial page and article on page 25.

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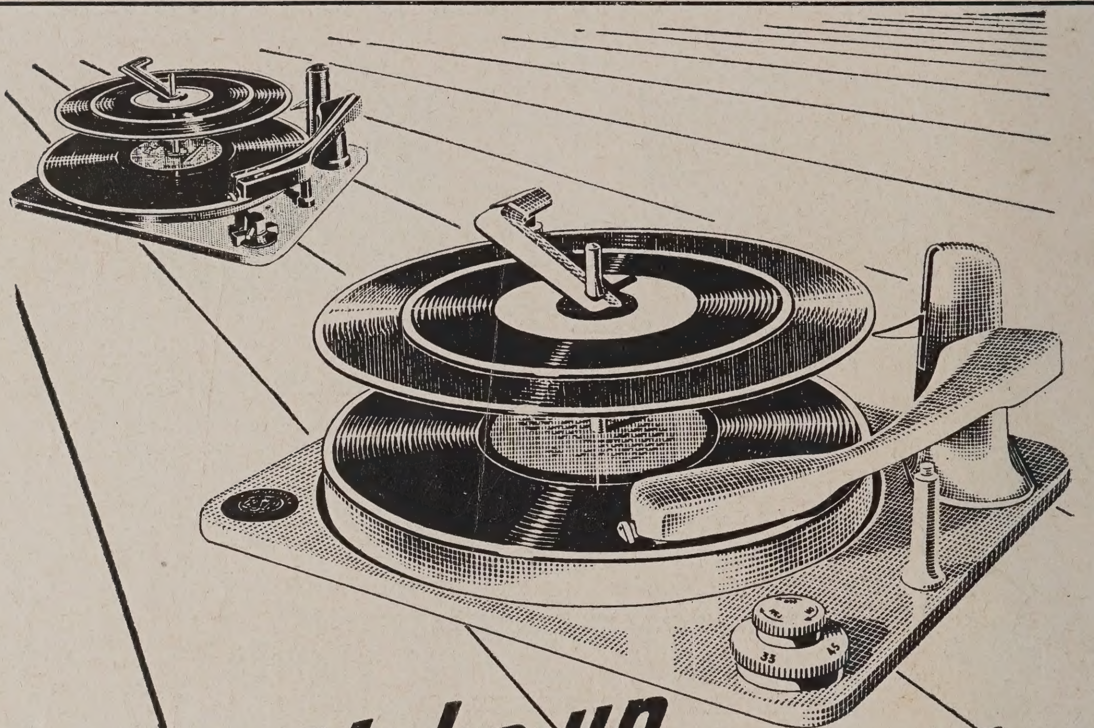

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Compatible Colour Television In Britain

This month, readers will have noted a departure from our usual practice in that this issue of *Radio and Electrical Review* sports a cover illustration in full colour. This is reproduced from a 35 mm. colour transparency, and, at first sight, does not appear in the least unusual. Nor, on first reflection, does it seem very appropriate as a cover picture for a journal such as this. Its suitability is apparent, however, when it is realized that this signifies a most important and noteworthy advance in British television—an advance, moreover, which may well have its repercussions on this side of the world.

The illustration is a reproduction from a colour photograph taken of the screen of a colour-television receiver, working on the British standard of 405 lines, 25 pictures a second. However, its importance to the TV world lies not simply in that, but in the fact that the signal used to produce this result is one not only fully compatible with the present British system of black-and-white transmissions, but taking up no more bandwidth than does its black-and-white counterpart.

It is not so long since television pundits held that an acceptable colour system could not be built round the existing 405-line system. It was considered that, when the time came for the commencement of colour TV broadcasts, Britain would have to scrap her old standard, and all the receivers that went with it, and start afresh on a new standard allowing a compatible colour system of satisfactory definition to be used therewith. Luckily, the authorities holding this opinion reckoned without the ingenuity and resource of present-day engineers. By a series of remarkable researches, the latter have developed a compatible colour system taking up no more bandwidth than a monochrome picture signal and able to be "translated" with very little difficulty from one set of standards to another.

So far as we are aware, these developments have taken place almost entirely in America, where the question of colour standards has been a very thorny one for some time. Perhaps the greatest spur was the somewhat peculiar decision of the United States Federal Communications Commission to sanction colour transmissions by the field sequential system. This gives good colour rendering, but is not compatible, uses up more bandwidth per transmission than does monochrome, and relies, in part, on mechanical devices. The F.C.C. decision caused grave consternation in the American electronics industry. As a result, several major firms, including the Radio Corporation of America, who were pressing on with the development of all-electronic compatible colour systems, redoubled their efforts, in conjunction with an intensive study of the problems involved by the National Television Standards Committeee. In an incredibly short time, considering the difficulties of the project, the pooling of all this research led to the design and demonstration of a practical system having acceptable picture quality.

In Britain, the Marconi's Wireless Telegraph Company Ltd. set itself the task of adapting the N.T.S.C. transmission standards to those of the existing British television service, and on May 11 of this year demonstrated the resulting experimental equipment. The latter was designed to show the results to be expected from a complete "translation" of the N.T.S.C. system in terms of 405 lines, as well as various different systems, using some, but not all, of the special techniques employed by the N.T.S.C. scheme. Our cover picture gives at least some idea of the excellence of the results obtained. Alas, it cannot be said to be a true idea, for, after reproduction on the screen of the colour receiver, this picture has undergone two further technical processes, being first photographed as a Kodachrome transparency from which tri-colour printing blocks were made. Though capable of excellent colour reproduction, neither of these processes are perfect, as they involve problems of exact rendition of colour values, and, in the case of the blocks, the additional one of registration of three or more separate images during printing. Bearing this in mind, therefore, the result illustrated can be classed as truly remarkable, and indicative of the mastering of the technique of colour TV.

This once more underlines the amazing resources of modern electronics. Readers, however, may well ask why we accord such prominence to this technical news. The reason is not far to seek, for the Marconi demonstration may well be the means of advancing the introduction of "ordinary," or monochrome, television in this country. One of the excuses given by the present Government for delaying the advent of TV here is that it is advisable to await the outcome of certain unspecified technical developments before we ourselves do anything. This seems to us more of a lame excuse than a sound reason, but, if ever there was any sense in it, it was purely in relation to developments in colour television. The results of this latest demonstration prove, once and for all, that there are no technical grounds whatever for any further delay. This is a very good thing, for, without such proof, there always might have been some suspicion, however slight, that the introduction of colour might cause embarrassment to any country operating the British 405-line system. Though it may not be a large one, we are now a step farther towards the introduction of TV in our country.

Before concluding, we desire to make grateful acknowledgment to those who have enabled us to provide readers, so soon after the event, with the "hottest" news in the television world today. Mr. H. F. Smith, the editor of our distinguished contemporary *Wireless World,* was kind enough, the day following the first demonstration, to air-mail us a large quantity of technical information provided by the Marconi Company. This included four colour slides, one of which has been reproduced as our cover picture. For the provision of the colour blocks for this we are greatly indebted to Messrs. Amalgamated Wireless (Australasia) Ltd., Wellington, New Zealand representatives of the Marconi Wireless Telegraph Company, and to whom we express our grateful thanks.

Audio Amplifiers

A MEDIUM-POWERED HIGH-QUALITY AMPLIFIER

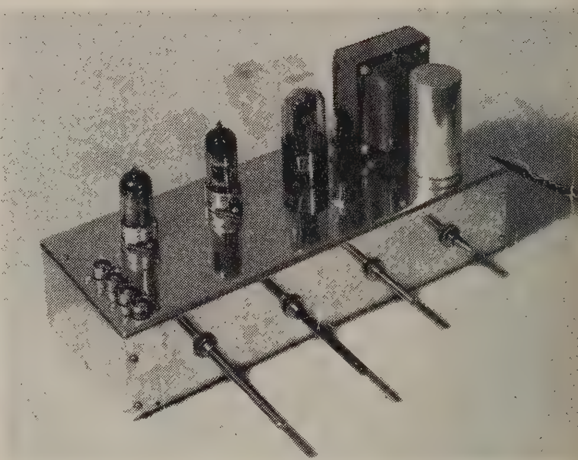
Part 2: Pre-amplifier and Tone-control Circuit

INTRODUCTION

In last month's issue of *Radio and Electrical Review* we commenced the description of a complete audio system, under the same heading as appears at the head of this article. The circuit and chassis diagrams for the main amplifier were printed there, and the main features of the system were outlined. This month we continue with a description of the pre-amplifier and tone-control section of the system, which is built separate from the main amplifier, and has its own power supply. By means of this form of construction, all controls are concentrated on the pre-amplifier chassis, which, if desired, can be remote from the main amplifier and speaker system.

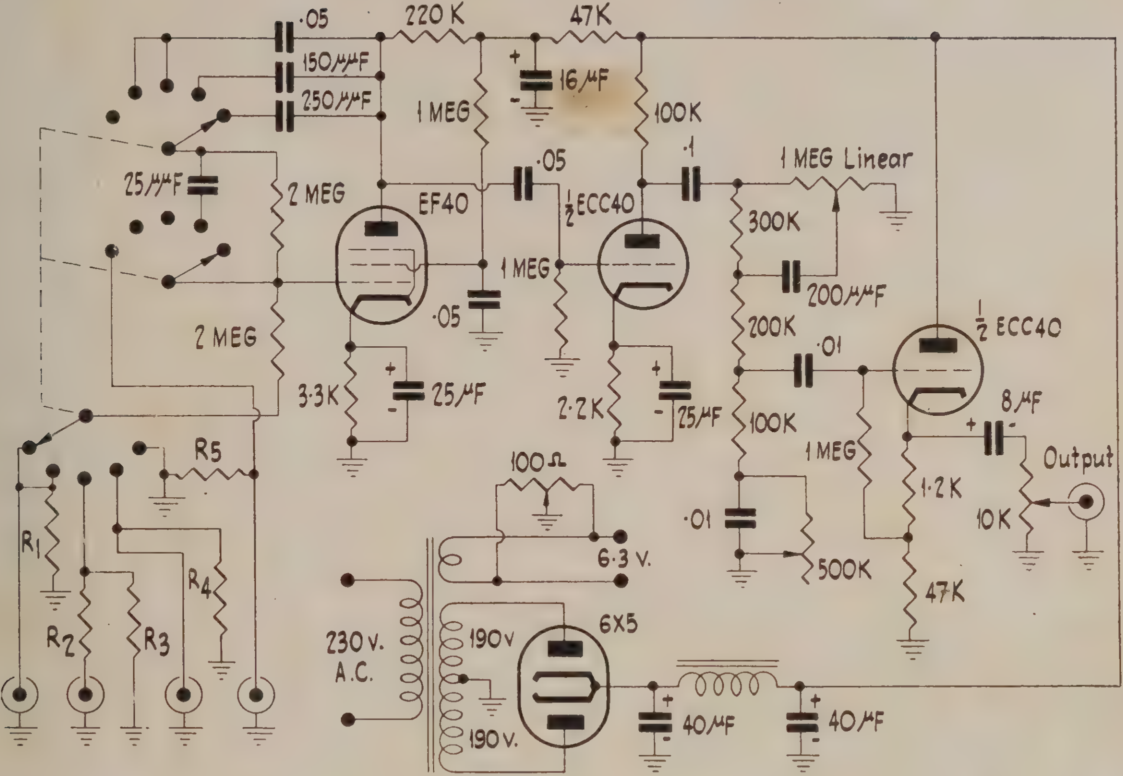
COMPREHENSIVE INPUT ARRANGEMENTS

In order to make the pre-amplifier unit as universally applicable as possible, it has been arranged to four inputs, any of which may be selected by means of a switch. The pre-amplifier valve has a gain of unity in three of the four input positions, but on the fourth, the gain is some 150 times. On the "Gram" position, the frequency response of the EF40 is modified by negative feedback so as to suit either type of record. As a result, there are five switch positions, but only four input sockets. The response compensation is done in the way that readers will have come to recognize as almost standard in *R. & E.* circuits, and as this method has been described on a number of previous occasions, we will not enlarge upon it here. In the circuit diagram, the switch has been drawn in the "78" position. Next comes the "L.P." position. On both of these positions it will be noticed that the same resistor R_1 is connected from the input terminal to earth. This is the load resistor recommended for the pick-up used, and so it has not been possible for us to specify its value. It can vary from as low as 10k. to as much as 250k., according to pick-up type. The contacts on the first two positions in the lower switch gang have been joined, so that only the one resistor need be used, and so that the pick-up is selected on both positions. The upper switch gang selects the blocking condenser to be used in each switch position; on 78, 250 $\mu\mu$f. is used, with 150 on L/P. Followers of our circuits will note that these values are rather smaller than we usually employ in this position, but this is because the associated resistors in this case have been raised in value to 2 megs. each. This has been done with a purpose, which is as follows. The pick-up is in series with the lower 2 meg. resistor, and in the case of high-impedance pick-ups, their impedance at high frequencies is likely to be quite high. Should the pick-up impedance become an appreciable fraction of the value of the lower resistor, then the effect will be to modify the feedback in such a way as to decrease the high-frequency response. There is a case, then, for making the resistor in series with the pick-up as large as possible, in order to minimize this effect. Hence the value of 2 megs. The choice of the same value for the upper resistor (i.e. the one between the blocking condenser and the grid) has the effect of reducing the stage gain to a value of one. In the present case this is very desirable, since we do not need any voltage amplification from the compensation stage.



View of the completed pre-amplifier. The input sockets can be seen at the left of the chassis, near the selector switch and the EF40. The controls, reading from left to right, are as follows—Selector switch, treble control, base control, and volume control. The output socket, and an octal socket from which heater and H.T. power may be drawn for a tuner are on the back of the chassis, and cannot be seen in the photograph. The round object in front of the power transformer is the dual 40 μf. smoothing condenser.

In the third switch position, it will be seen that the second input socket is selected. In this position, the blocking condenser is raised to 0.05 μf. The effect of this is to give the stage a flat frequency response, making it suitable now for feeding in the output of a radio tuner, or other device which itself has a flat response. On the bottom switch deck it will be seen that from the input socket to earth is a voltage divider, with the input to the valve taken from the tapping point. This has been shown because the overall gain of the main amplifier and pre-amplifier will be much greater than is needed for fully loading the amplifier from the output of a radio tuner. The amount of voltage division used will depend on the maximum output of the radio tuner, so that once again it is not feasible for us to specify the values of R_2 and R_3, which will have to be individually chosen by the user. In the next position of the switch, the upper switch bank still selects the same blocking condenser as before, from which we can deduce that again the response is flat. This time we have shown a single resistor instead of a voltage divider from the input terminal to the grid. The idea is that in this position, the full gain of the pre-amplifier and main amplifier is available for use with such things as high-level microphones or tape-recorders. R_4 in this case is arranged to



suit the loading requirements of the device that is being used.

On the fifth switch position the negative feedback is disconnected, so that the full gain of the EF40 is available. The bottom switch bank in this case earths the lower end of the bottom 2 meg. resistor, and the middle bank connects the input straight to the grid of the EF40. This high-gain position will be useful for feeding in a crystal or dynamic microphone, since the input voltage required for full amplifier output will be not more than about 0.1 millivolts. From this description it can be seen that the pre-amplifier unit will suit not only this amplifier, but any amplifier at all, almost, and still have enough gain to operate it from any kind of input device, whether microphone, tape deck, gramophone pick-up, or radio tuner. It should thus meet readers' needs, whatever their main amplifier may be like, and whatever they wish to feed into it.

TONE CONTROL STAGE

There are only two valves in the pre-amplifier circuit, apart from the power rectifier. The second one, an ECC40, is used half for the tone-control stage, and half as an output cathode follower, which feeds a low-impedance volume control.

The first half is a conventional resistance-coupled stage with a load resistor of 100k., giving it a stage gain of 24 times. The tone control network which follows it, however, acts as a voltage divider at middle frequencies, passing on only one-sixth of the output of the amplifier. Consequently, the effective gain of the tone control stage is only four times.

The network at the output of this stage is the one which produces the variable bass boost, and treble boost or cut. If the 1 meg. linear potentiometer and the 200 μμf. condenser are imagined taken away, we are left with the bass boost circuit, which then boils down to a 500k. resistor, a 100k. resistor, and a condenser of 0.01 μf. in series. Across the condenser is a 500k. pot. which controls the amount of bass boost actually used.

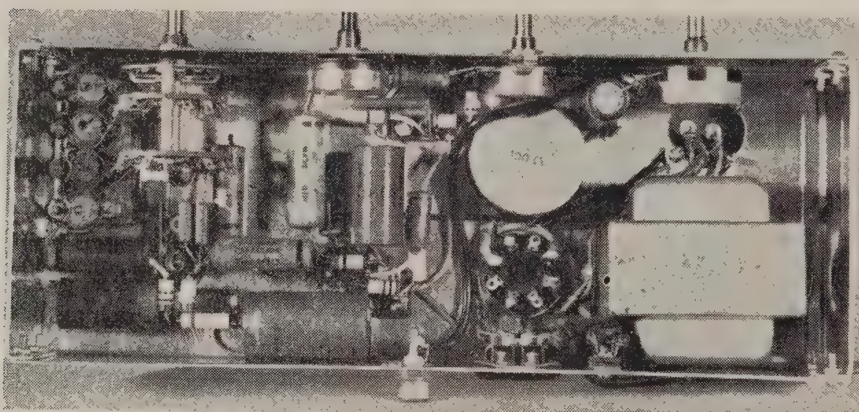
This is the sort of network which can be used for obtaining the bass compensation for recording characteristics, and which was in fact used considerably before the negative feedback type of circuit was evolved. Here, the proportions are different, so that the maximum boost obtainable at a frequency of 50 c/sec. is 7½ db. This is quite sufficient for adding the extra little bit of low-frequency response which may be needed and yet not enough to introduce difficulty with hum, or over-control on the part of an experienced operator. The accompanying curves show the maximum amount of bass boost available, and any intermediate degree can be obtained by using the control which shunts the 0.01 μf. condenser.

The treble boost and cut circuit comprises the 1 meg. linear potentiometer and the 200 μμf. condenser. To see how this works, it is best to imagine the control at both of its extremes. At one end, the 200 μμf. condenser is connected directly across the 300k. resistor, in which position it bypasses the highest frequencies round the top half of what is effectively a voltage divider consisting of two 300k. resistors. (The 0.01 μf. condenser has no effect, because at high frequencies its reactance is so small that effectively it is a short-circuit.) This results in a maximum boost of 6 db., which the curves show is obtained at approximately 12,00 c/sec. At the other extreme, the 200 μf. condenser is earthed, so that now it is bypassing the lower resistor of the divider, and giving top cut. The extent of the cut is rather

greater than the boost, because a very small amount of cut is not of very much use.

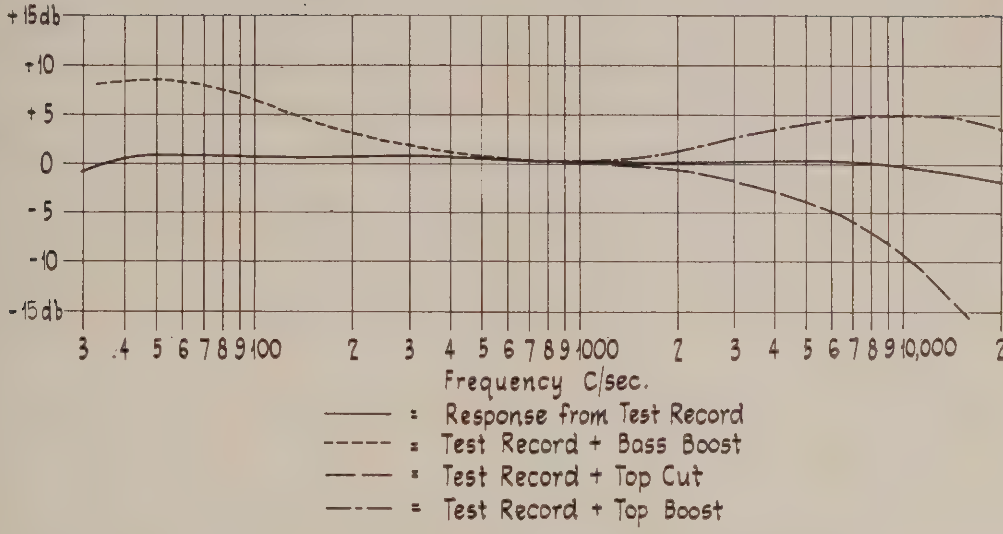
The output of the tone control network feeds into the grid of the second section of the ECC40, which is a cathode follower. The arrangement of using a cathode follower to feed a volume of 10,000 ohms is rather an unusual one, and merits some explanation. On the face of things, putting a control of 10,000 ohms *after* the cathode follower looks rather like wasting the latter's low impedance. Actually, its function in this circuit is to allow us to use a relatively low-impedance volume control, by acting as a buffer between the tone control circuit and the volume control. Would it not have been better, though, to place a high resistance volume control in front of the cathode follower, and thus make use of the very low-impedance output characteristic of the latter? This was purposely not done, because of the possibility when so doing of introducing hum from the cathode follower. The way we have shown avoids this, by ensuring that at all times the signal at the cathode follower is very much larger than the hum voltage is ever likely to be. As the main amplifier is quite sensitive, the output of the cathode follower would be only some 60 millivolts, if the full gain of the main amplifier were used all the time. By putting out a large signal from the preamplifier, and then using the controls on the main amplifier and at the output of the pre-amplifier to select only that portion of it that is required, we ensure that hum is over-ridden, whereas if the volume were controlled before the cathode follower, we could find the latter working with a signal of only a few millivolts, which may not sufficiently over-ride the hum generated in the cathode follower. The main purpose of having a low-impedance output from the pre-amplifier is to ensure that a long output line does not pick up hum itself, or that if this line is shielded to avoid hum pick-up, the high capacity of the shielding does not cause undue high-frequency loss. A volume control of 10,000 ohms is low enough to prevent hum pick-up on the part of the line, and yet is much too low to allow it to be fed straight from the tone-control network. Hence the need for a buffer stage. It would have been possible to use a much lower resistance volume control were it not for the fact that this would require an exceptionally large coupling condenser. As it is, an 8 μf. electrolytic has to be used in order to prevent loss at the low frequency end. The use of an electrolytic coupling condenser in this way is quite in order, since it has a D.C. polarising voltage of over 50 on it, while the A.C. voltage, or signal, is only a few volts. A good electrolytic will have very small leakage—so small indeed that it can be entirely disregarded. However, care should be taken to see that a high-voltage electrolytic condenser is used in this position, and not a 50 volt one, because the latter types have rather too much leakage for such an application.

The power supply is quite conventional, and produces about 200 volts D.C. A 30 ma. transformer was used, with the idea that it will come in handy for feeding a radio tuner. To that end, an octal socket has been placed on the back of the chassis, with the heater and H.T. voltages wired to it, so that the amplifier just fails to overload on the loudest passages of music. This control is then left in this position, and all volume control is then done with the one on the amplifier chassis. It will now be found (if everything is correct) that the hum, which might still have been audible with all controls at maximum, is quite inaudible, or at least, so low in level as to be negligible. Tests on the original units showed that, using one well-known and popular make of magnetic pickup, hum and noise were 60 db. down on the maximum level.

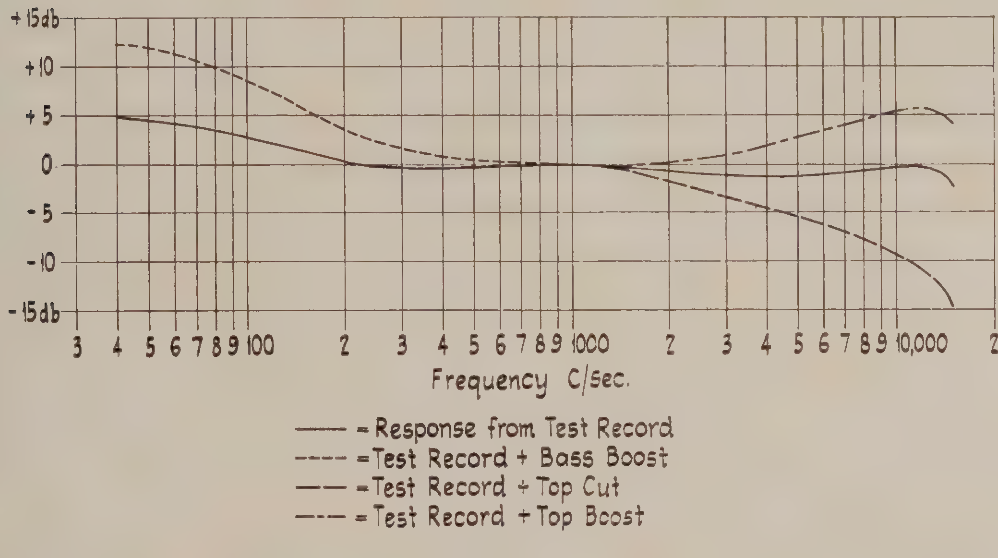


MAIN AMPLIFIER FEEDBACK CONNECTIONS

In the circuit diagram of the main amplifier, the components in the feedback work have been specified for the case where a 15 ohm speaker is used. If a speaker of different impedance is used, it will be necessary to make changes in two of these feedback components. From the "high" end of the voice-coil comes the feedback voltage divider, consisting of 75k, resistor will need changing for speakers other than 15 ohms. The following table indicates the values that should be used for various common speaker impedances. The output transformer recommended (viz. the one used in our prototype) has four secondary windings which may be connected in various ways in order to match different speaker impedances. These are (nominally) 16, 9, 4, and 1 ohm. If, for instance, it is desired to use a speaker that is not close to any of these values, it will be necessary to use a different transformer. However, the makers of such things will certainly make special ones to individual order, at only a small additional cost, so that there should be no difficulty. It is helpful to remember, too, that if the speaker impedance quoted does not tally exactly with the nominal impedance given for a certain secondary, no harm will be done provided the departure is not too great. For instance using a 15 ohm speaker with the transformer connection rated nominally at 16 ohms will have a quite negligible effect on performance. The reason is, of course, that speakers, in spite of the figures quoted on them, are by no means constant-impedance devices. It is purely a matter of convention to quote their impedance at 1000 or at 400 c/sec., and it must be confessed that as far as matching is concerned, it



Response curves of the pre-amplifier when used on 78 R.P.M. records, with various settings of the variable controls. The curves shown indicate the maximum effects of the controls.



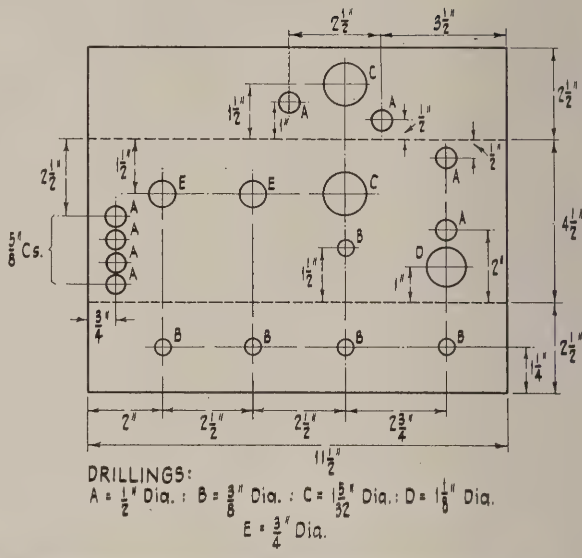
Similar response curves to those above, but taken in the L/P position of the selector switch, and using a Decca L/P test record LXT2695.

will make little difference if the nominal speaker impedance is within 20 per cent. either way, of the nominal for future use with a tuner if required. *It is not recommended that the pre-amplifier should be powered from the main amplifier.* If it is, there will be a strong possibility of motor-boating, especially in the high-gain position of the switch. The slight extra cost of the separate supply is more than justified by the certainty of freedom from this sort of trouble, which can be a real headache, and by the facility which it provides for running additional equipment from it, also without fear of interaction with the main amplifier.

CONSTRUCTION

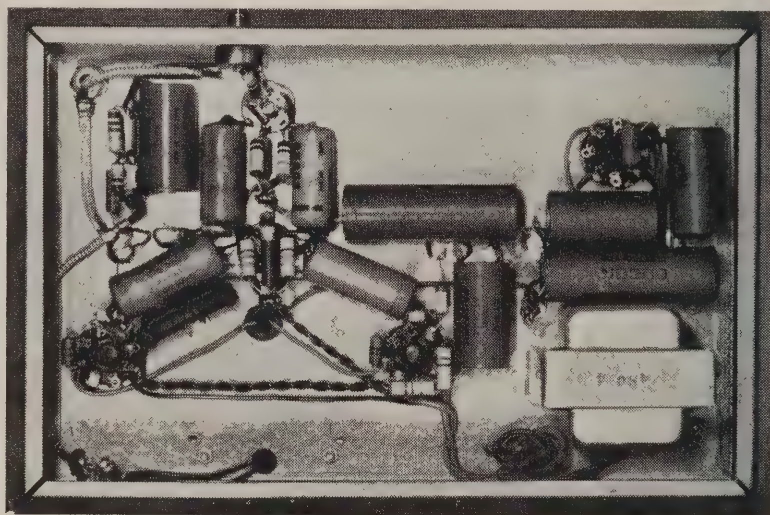
There should not be much need to enlarge upon this aspect of the pre-amplifier, because the photographs give a good idea of the placement of the parts. The only point requiring particular care is the wiring of the filaments. This should be done with well twisted hook-up wire, and the filaments must not be earthed except at the moving arm of the 100 ohm "hum-dinger" potentiometer. This is mounted in a blank space near the middle of the chassis, and the moving arm can be earthed to any convenient spot, provided it is a solid earth to the

chassis. If a steel chassis is used, make sure that the soldered joint which earths the heater circuit is a good solid one, and NOT a dry joint. If the chassis is of aluminium, firmly bolt a solder-lug to the chassis close to the potentiometer.



HUM AND NOISE

As we have explained, the main amplifier is quite a sensitive one, and there is a small over-all gain in the pre-amplifier itself. As a result, there is enough gain to spare, so that if both volume controls are turned "flat out," it is too much to expect that no hum will be heard in the speaker. Indeed, without the hum-dinger adjusted, it is likely that with all controls at maximum, there will be quite a loud hum. Thus, after initial checks that everything is working, the pick-up to be used should be plugged into the pre-amplifier, and all controls turned to maximum. The hum-dinger is then adjusted carefully for minimum hum. Next, set a record playing, with the switch in the right position to suit it (i.e. 78 or L/P). At first turn both volume controls right off. Then, turn the one on the pre-amplifier full on, and carefully advance the one on the main amplifier. On the loudest part of the record, which should be one with some heavily-recorded passages on it, set the main amplifier volume control transformer secondary impedance. One thing that many builders do not realize is that a transformer really has no impedance of its own. What is meant by stating that the secondary impedance is 15 ohms is *not* that the secondary *has* an impedance of 15 ohms, but that it will suit, or match, a speaker of that impedance, provided that the valves, which are connected on the primary side, have a certain impedance, which is also stated on the label. By using a transformer with a certain turns ratio, all we are doing is to transform the speaker impedance to a suitably higher value for matching the plate circuit of the valves in the amplifier, so that a slight departure from the nominal figures merely means that the load on the valves will not be quite what it would be if the nominal figures were exactly matched. So do not be afraid to use, say, a five-ohm speaker with a transformer which purports to match the valves concerned to, say four ohms. Except by the careful use of instruments, no one could possibly tell the difference. Moreover, this is fact, not merely a personal opinion.



Under chassis view of the main amplifier, whose circuit was given in the June 1954 issue.

Speaker impedance	Feedback resistor
15 ohms	75 k.
9 ohms	56 k.
4 ohms	37.5k.
2.5 ohms	30 k.

Television

COMPATIBLE COLOUR TV DEMONSTRATED IN ENGLAND

One of the most important television developments since the war has been the production in the U.S.A. of a colour system which is not only fully compatible with existing black-and-white transmissions, but also takes up no more band space. Until recently it had not been shown practicable to modify the American colour system to suit the British 405-line standard. As recently as 11th May of this year, the British Marconi Company demonstrated fully compatible, all-electronic colour TV using the British standards.

INTRODUCTION

It might be thought at first glance that an event such as that summarized above could have little practical interest for us in New Zealand, but, owing to a combination of circumstances, this is far from being the case. Indeed it could well have a direct bearing on the speed with which a New Zealand television service is planned and put into operation. We do not propose to deal with this aspect of colour TV in this article, since we have done so elsewhere in this issue. This story is a semi-technical one, intended to describe, as simply as possible how compatible colour transmissions are made, and how it is that they need not take up any more spectrum space than an ordinary black-and-white transmission, even though they contain a good deal more information. The subject is a fascinating one, and shows how TV, which already appears to many of us to be sufficiently complex, will in the foreseeable future become even more complicated in detail. However, as with ordinary TV itself, the principles are simple enough; it is their application in practice that ca forth the need for complicated equipment, which is nonetheless understandable for all that.

GENERAL PRINCIPLES

Before considering the colour aspect, it may perhaps be of assistance to recall the basic principles of monochrome television.

Monochrome transmission of pictures is initiated by sweeping an electron beam, or spot, systematically across every point of an image of the scene which is being broadcast, the entire picture being swept or scanned (in the British standard of transmission) in 405 lines. In this manner, 25 pictures, or frames, are scanned per second. Every variation of light or shade encountered during this process by the electron spot is faithfully translated into variations in electrical impulses. These impulses, after amplification, are duly transmitted, to be picked up by the receiver.

In the cathode-ray tube of the receiver another electron spot is scanning the fluorescent coating which forms the presentation screen, in exact synchronism with the one scanning the image at the transmitter. Thus, when the transmitter scanning spot is directed at the upper left-hand corner of the image, the receiver's cathode-ray spot is likewise impinging o top left-hand corner of the screen, and similarly throughout the whole scanning process the two re-

A Colour Camera in action at the Marconi demonstration on 12th May, of this year, less than six weeks ago.

main exactly in step, maintained thus by synchronizing pulses from the transmitter.

The light-variations, converted as stated into electrical variations and transmitted to the receiver, are fed to the cathode-ray tube in such a manner as to increase or decrease the flow of electrons in the beam. These electrons, on striking the fluorescent screen cause it to glow at the point of impact. The more electrons there are in the beam the brighter the spot, and vice versa. The amount of light emanating from any point on the transmitting scene is thus reproduced at exactly the same relative brightness, at the same relative spot on the receiver screen. The picture is in this way built up spot by spot, being relatively sluggish in its reactions, seeing the result as a complete picture. In other words, "persistence of vision" enables a continuous picture to be presented providing the frame rate is 25 per second.

Colour television represents a considerable extension of this process, as in addition to the monochrome picture, information on the colours involved has also to be resolved into electrical impulses and transmitted together with a more complicated system of synchronizing pulses.

In practice, matters are made a little easier by virtue of the fact that the transmission of three primary colours will suffice, for by combining these colours in suitable proportions almost any colour

can be produced. Red, green, and blue thus combined in the correct proportions give white light; yellow is produced by combining green and red, and so on.

In parenthesis, it is felt that the above statement needs some qualification, particularly to those with memories of watercolour paint mixing, by whom green is regarded as a secondary colour, produced by mixing yellow and blue (cyan), and who know that a mixture of red, green, and blue pigments most certainly does not produce white paint.

The short answer is, that there are two basic systems of colour mixing, the "additive" and the "subtractive." The additive is concerned with the mixture of light sources; for instance, if a beam of pure green light is projected on to a white screen on top of a beam of pure red, the area of intersection of the two beams on the screen will appear as yellow. The additive system is the one used in television, with red, green, and blue as the primaries.

The subtractive system (into which category watercolour paint mixing falls) interposes a filter, or filters, between the eye and the source of light. Certain light frequencies, or colours, are thereby subtracted by the filters, and the eye sees what remains. Thus, if a cyan filter is laid upon a yellow, and the two are held between a source of white light and the eye, the light penetrating the two filters will be green.

The problem, therefore, apart from the additional synchronizing problem, resolves itself into that of breaking down a multi-coloured image into its red, green, and blue components, converting them into electrical impulses in such a manner that they may be identified in terms of colour at the receiver, transmitting these impulses, and reconstituting them at the correct point on the screen, in correct colour, and in correct proportion. Some idea of how this is done, with particular reference to the Marconi equipment used in the recent demonstrations, is given later.

SAVING BANDWITH

It will be apparent that a colour television transmitter has to send out much more complex signal information than its black-and-white counterpart—in point of fact up to three times as much. Any transmitter, whether sending telegraphy, sound, or vision, requires ether space, or bandwidth, in order to do it, and the more complicated the signal, the more space it needs.

Of the three, the signals required to transmit a television signal are by far the most complicated, and require the allocation of a wide band of frequencies. The standard channel width in Great Britain is 5 mc/sec., of which 3 mc/sec. is occupied by the vision signal. Colour television, therefore, in its simplest form, would require three times the channel width to transmit it, which on the face of it would mean an allocation of 10 to 15 mc/sec. of bandwidth for each transmitter. Unfortunately, on any given frequency band there is accommodation for a finite number of stations, so that if each station doubled its bandwidth, there would be room for only half the number. Some method must therefore be found to compress the colour television information into a narrower bandwidth.

Another view of one of the Colour Cameras which were specially developed by the Marconi Company for the demonstration. Being experimental equipment, it does not include a view-finder, but its small size is noteworthy, in that it includes the two camera tubes necessary for generating the colour.

THE SAME PROBLEM EVERYWHERE

This problem of available ether space is, of course, by no means peculiar to Britain. In America the problem is far more acute, and the National Television Standards Committee (referred to as the N.T.S.C.) was some time ago set up to examine the possibilities of compressing the colour information, and, if possible, to evolve a set of workable standards.

After a vast amount of research (in which the Radio Corporation of America took a leading part, supported by the Hazeltine Laboratories and others) and an unprecedented pooling of information within the American television industry, the Committee's recommendations and specifications were published for apparatus which will compress the colour information into the same bandwidth as is now used by a monochrome television transmitter—a truly notable achievement.

The system achieves the desired result by means of two techniques which can be described as "band-saving" and "band-sharing." The first of these depends on the fact that human eye gradually loses its power of colour discrimination in those parts of a scene or picture where the fineness of detail is increased. Furthermore, the occurrence of scenes in which the colour in the fine detail is important, seems to be rare. Both these factors permit the definition (and thus the bandwidth) of the colour components of the signal, to be considerably reduced. The "band-sharing" part of the system consists in fitting the reduced definition colour signals, resulting from the "band-saving" into the

vision signal, without increasing its bandwidth. This raises certain problems, particularly those of interference, or "crosstalk" between the two sets of signals which have been fitted together. In the American N.T.S.C. system many ingenious compromises have been achieved, inducing the reduction of cross-talk to a minimum.

Equipment built to N.T.S.C. standards, but modified by Marconi's to meet British requirements, was demonstrated, together with a "Wide-Band" system which takes up more ether space, but which avoids the cross-talk mentioned. To sum up, both N.T.S.C. and the British Television Advisory Committee are unanimous that one basic requirment of any colour television system should be compatibility.

COMPATIBILITY

Compatibility in this context means that any system of colour television should be of such a nature that existing monochrome television receivers should be able to pick up the colour transmission, and render it (in monochrome of course) without serious loss of definition, and without the need for modification to the receiver. It is likewise of equal importance that any colour receiver should be able to receive and display monochrome transmissions, as such, because even with a colour television service in operation, it would seem improbable that every transmission would be in colour.

HOW THE COLOUR SYSTEM WORKS

All of the above really does little more than introduce the subject of colour television, and show what the system must do if it is to comply with all the requirements. It should be noted that of these, only one is the production of a colour picture, as such. Many of the technical details have been dictated by entirely extraneous matters, such as the over-riding need for compatibility with existing services. How the system works in practice is a very different matter, and one which will take more than a short article to describe adequately.

Apart from the manner in which the colour information is originally obtained at the transmitter (which is a large topic all on its own) the most interesting thing about the N. T. S. C. system, and its derivitive used by Marconi's is the "band-sharing" scheme. Briefly, this depends on the fact that a black-and-white television signal does not utilise at all efficiently the large slice of bandwidth which it takes up. The sidebands are usually thought of as occupying the whole space between the carrier frequency and the edge of the signal band, but in practice a great deal of this space is wasted. This is because the sidebands occur only in clusters, each cluster centred on a frequency spaced from the carrier by a multiple of the line-scanning frequency. In the British system, the lines are scanned at a frequency of 10,125 lines per second, so that there is a cluster of side frequencies centred every 10,125 c/sec. away from the carrier frequency. In between clusters, there is largely empty space. It is in this space that the colour information is inserted. This can be done because the colour information itself, when modulated on to a carrier, also consists of sidebands spaced from each other by the line frequency. Thus, by correctly choosing the colour carrier frequency so that it is half an odd multiple of line frequency away from the normal carrier, we find that the clusters of colour sidebands fall right into the spaces between the clusters of black-and-white sidebands. The process is often referred to as "frequency interlacing." Space does not permit of a full technical discussion here, but we hope in an early issue to give readers a fairly full dissertation on the working details of the complete colour system.

BOOK REVIEWS

"INTRODUCTION TO VALVES"

By R. W. Hallows, M.A. (Cantab.) M.I.E.E., and H. K. Millward, B.Sc. (Lond.), A.M.I.E.E. Publishers, Iliffe and Sons Ltd.

This book describes the principles of operation of the radio valve, and its uses in circuits of various types. Commencing with a simple explanation of the fundamental action of the diode, it deals with diodes as rectifiers and detectors, triodes in their common applications, tetrodes and pentodes, multi-grid valves for frequency-changing, power output valves, and valves for V.H.F. and E.H.F. operation.

As its title implies, the book is addressed mainly to novices and elementary students, but we would go so far as to say that it should be read by many technicians who would not include themselves in either of these groups. The authors make liberal use of potential-gradient diagrams, with the result that while the text is eminently readable, and entirely non-mathematical, it successfully fills the gap between the very elementary text, useful only to a schoolboy, and the kind of treatment which is so advanced as to be readable only by someone with an extensive physical and mathematical background.

It is surprising how many radio technicians have only a very limited appreciation of just what does go on inside a "tube," and in our opinion, this book would repay study by almost anyone interested in valves, except, of course, those whose knowledge of theoretical electronics is fairly extensive.

"TELEVISION FUNDAMENTALS"

By K. Fowler and H. B. Lippert. Publishers, McGraw-Hill Book Company Inc., New York and London.

In the author's preface to this book they say that it is intended to provide "a course of study and a reference volume for technicians and students who may eventually have the responsibility for installing and servicing television receivers." The authors go on to say that the text was prepared on the assumption that that the reader would have little or no experience in television, but would have a good fundamental knowledge of the "radio" circuits that go to make up the more complex television circuits.

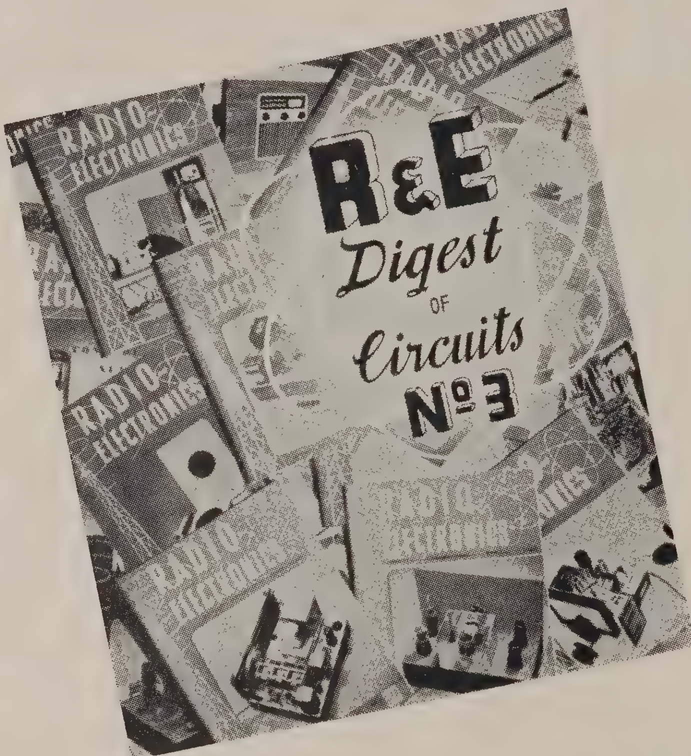
The book certainly lives up to this description, and also to their claim to have "very little reference to mathematics."

The material is presented in a very logical manner. Chapter 1 gives a brief description of the television system as a whole, and Chapter 2 describes the picture tube and the basic requirements in producing a picture on the screen. The third chapter goes on to complete specification of the transmitted signal, after which Chapter 4 outlines in a general way the functions that must be fulfilled by any receiver. In common with most American text-books on the subject, there is no reference to any but their own 525-line standard, but this is really a very minor disadvantage, in view of the remarkable correspondence between all the systems in actual use. Succeeding chapters deal with the various sections of receivers, starting at the aerial terminal and finishing with power supplies. After this there is a lengthy chapter on aerials and their installation, followed by test equipment and receiver alignment, and servicing. At the end of the book is a most excellent record of individual faults, as observed on the screen of the tube. With each of these is a small circuit showing the portion of the set affected, together with a statement of just how the fault illustrated was artificially produced, and a list of other faults in the same portion of the receiver, which would produce similar observed effects. This section of the book is likely to be much more valuable to technicians than similar sections in many others we have read, in which only vague statements are made about the cause of the illustrated faults.

We had hoped that here, at last was a book which described without ambiguity, and without confusing the reader, the difficult

(Concluded on page 32)

Circuits for Everyone



in the

"R and E" Digest of Circuits No 3

price 3/6

To be Published Shortly

In a digested form, this 96-page book contains basic constructional data on all the equipment described in "Radio and Electronics" and its successor, "Radio and Electrical Review," from February, 1951, to June, 1954, inc. As with the two previous Digests, the scope of this book is extremely wide, ranging from the simplest to the most advanced radio sets, amplifiers, test gear, etc. All essential data are given, together with references to the original descriptive articles which appeared in "Radio and Electronics."

NOTE: None of the material in "Digest No. 3" has appeared in the two previous Digests.

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News from the New Zealand Electronics Institute (Inc.)

ADMISSIONS TO MEMBERSHIP:

At the Dominion Council Meeting on 6th May, 1954, the following were admitted to the N.Z.E.I. (Inc.)

Graduate: H. D. Purves, Dunedin. G. A. M. King, Christchurch.

Associate: N.H. White, Bluff.

Associate Member: T. R. Mooney, Christchurch.

Associate to Associate Member: W. E. H. Docherty (Transfer from Wellington to Christchurch Branch).

DUNEDIN BRANCH ANNUAL MEETING:

At the Annual Meeting of this branch, held on 27 May, 1954, the following officers were elected. Chairman, Mr. W. L. Shiel; Vice-chairman, A. R. Harris; Hon. Secretary, E. S. Andersen; Hon. Treasurer, W. McInnes; Committee, P. J. Holden, K. Shore, H. G. Hedge; Social Committee, L. W. Clarke, F. M. Gillies, A. J. Trinder, A. E. Adam, J. G. Walker.

Following the formal business, Mr. W. G. Collett, M.A., spoke on "How to prepare a technical paper." This interesting and informative address had been specially prepared for the help of those interested in the forthcoming lecture competition. The appreciation of the Branch is expressed to Messrs. Philips Electrical Industries of New Zealand Ltd. for their generous donation of two substantial prizes for this competition.

LECTURE COMPETITION (June, 1954—May, 1955).

Open to financial branch members only, a lecture competition will be held by the Dunedin branch during the year June, 1954-May, 1955.

The competition will be divided into two sections, viz:

Senior: Open to all Members and Associate Members.

Junior: Open to all Grades lower than Associate Member.

Through the courtesy of Messrs. Philips Electrical Industries of New Zealand Ltd. a substantial prize will be awarded each section, in the form of orders on this firm for goods. Thus members will have the opoprtunity of obtaining something useful, and, if they so desire, they may add to the award to obtain goods of greater value.

The judges are Mr. H. F. Symmons, B.Sc. Hons., Grad. I.E.E., A.M.N.Z.E.I., Physics Department, University of Otago, and Mr. L. H. Martin, A.M.I.E.E., A.M. Brit. I.E.E., District Engineer, N.Z.B.S.

The lecture may be given on any electronic subject, and judging will be on the following basis.

Primary Consideration:

(1) Context.

(2) Presentation.

Secondary Consideration:

(3) Manuscript.

(4) Questions.

(Note: Manuscripts must be handed in before or at the lecture).

The main points sought after under the above headings will be:—

1. Content:

(a) Correctness of material

(b) Interest to audience

(c) Originality of material, or the presentation of well known material.

2. Presentation:

(a) Clarity and audibility

(b) Use of blackboards and/or diagrams.

(Note: A higher standard will be expected of professionals and teachers.

3. Manuscript:

(a) Content

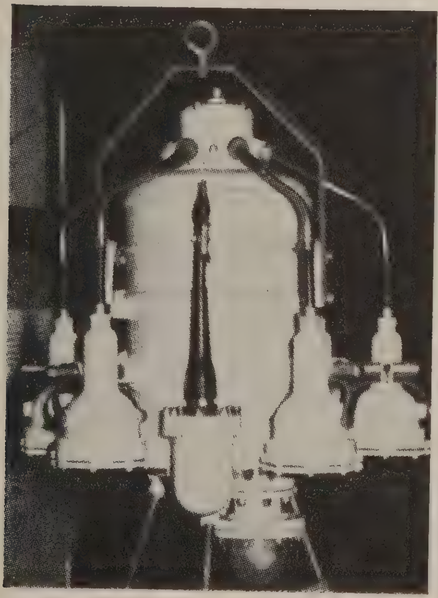
(b) English

(c) Carefulness of preparation.

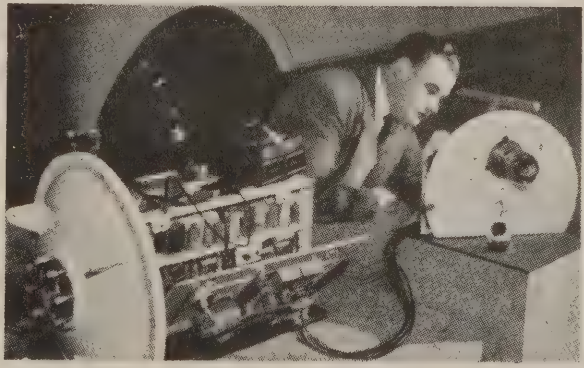
4. Questions:

(a) Ability to handle questions and discussions.

THE UNDER WATER TEST



Pictured above is the Marconi-Siebe Gorman underwater television camera, fitted with the new periscopic lens, supplied by Marconi's Wireless Telegraph Company Ltd., England to the British Admiralty and flown to the scene of the Comet crash



off Elba. Extraordinarily clear views of the wreckage were obtained, as described in our May 1954 issue. This new lens has several advantages. If, as is quite likely, the camera comes to rest at an angle to the wreckage, the "eye" is rotated by remote control, giving a field of search which greatly speeds up the work of salvage. The lens also aids viewing if the camera is yawing slightly with the current.

Readers will have noticed the recent announcement concerning the finding and salvaging of the tail piece of the Comet, which operations were greatly assisted by the use of this camera.

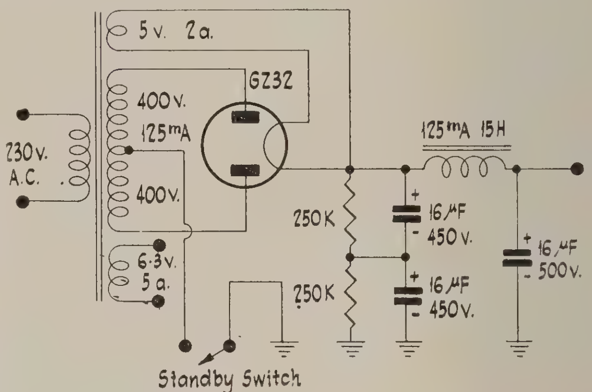
The other photograph shows Ron Swinden, television engineer of Marconi's Wireless Telegraph Company Ltd., who flew out with the underwater camera to the scene of the Comet crash in the Mediterranean. The equipment is similar to that in the first photograph.

The PHILIPS Experimenter

No. 81: A Transmitter for the Beginning Amateur (Part 2)

(4) CIRCUIT ARRANGEMENT (Continued)

The plate of the oscillator is capacity-coupled to the grid of the final, which has its bias provided solely by a 15k. grid leak. The correct amount of drive, and also of bias, for the final is obtained by adjusting the plate and screen voltage of the oscillator with the tapping on the 25k. bleeder, which is also used as a voltage divider. The oscillator is keyed by inserting a closed-circuit keying jack in the H.T. lead to the oscillator, both plate and screen voltage of which are cut off when the key is up. Because of this method of keying, no grid current can flow in the final when the key is up, and as no means is provided of providing alternative bias, this would result in the final drawing an enormous plate current under key-up conditions, were it not for the EL42 protective tube, which is connected in the screen circuit of the QE06/50. Now the screen of the latter is fed through a dropping resistor of 25k., which value is chosen because it gives the correct 250 volts for the screen when the key is down, and power is being produced. At this time, the final grid current is producing a grid bias of 45 volts. Now this negative bias is applied to the grid of the EL42 through a 1 meg. resistor, so that when the final is working, the EL42 is firmly cut off, and to all intents and purposes might not be there at all. But when the drive disappears, as when the key is released, the negative bias also disappears from the grid of the protective tube, allowing it to draw as much plate current as it can. But its plate is supplied with voltage through the screen dropping resistor, so that when the bias is removed, and the EL42 draws current, there is a large voltage drop through the screen resistor. This reduces the plate voltage of the protective tube to about 50 volts, and since the final's screen is directly connected to the EL42 plate, its voltage, too, is reduced to 50v. With only this much screen voltage, the QE06/50 cannot draw much plate current, so that when the excitation is cut off from the grid, the final can no longer draw a dangerously high current, and all is well. The protective tube also has a very beneficial effect on the stability of the power supply voltage, in the following way. If all the load is removed from an A.C. power pack, its voltage climbs considerably, so that when the load is suddenly applied, there is an equal drop in voltage. This drop between no load and full load is called the *regulation* of the power supply, and is obviously better the smaller it is. Now one way of improving the regulation of a supply is to see that no sharp changes of load occur. For instance, if we could arrange things so that the valves in the transmitter took the same current from the supply whether the Tx was radiating or not, there would be no change of supply



Circuit for a suitable power supply for the transmitter. Note that a 500v. electrolytic has been specified for the final filter condenser. The standby switch will be needed if the transmitter is used on 'phone, as without the key in the keying jack, the Tx. is continuously on.

voltage when the key was depressed or released.. It is not necessary to go to these lengths, however, and the usual precaution is to place a bleed current of a few milliamperes on the supply so that even if the tube current is zero, the supply current is not. Here, the voltage divider draws approximately 16 ma., whether the key is up or down; effectively, however, there is a much greater bleed current than this because both the protective tube and the final draw considerable current when the key is up. The whole circuit draws 75 ma. with the key up, and 125 ma., key down. Because of this, the change in voltage is not nearly as great as it otherwise would be, with beneficial effects on the oscillator circuit.

The next feature of the circuit that merits some mention is the final tank circuit. This has been designed to suit the conditions obtaining when a 400 volt power supply is used. In theory, the size of the coil, and thus the ratio of inductance to capacity, should be changed if higher plate voltages are employed, but this is hardly necessary. At 400 volts, the Q of the circuit under operating conditions will be about 12, which is enough to ensure good reduction of second harmonic output. It is for this reason as well that a fixed coupling link has been shown at the transmitter. This should more accurately be described as a pre-set link, since its position, and

hence coupling to the tank circuit is able to be varied by bending the heavy supporting wires. It is strongly recommended that the transmitter should be used with one of the aerial couplers described in every issue of the "Radio Amateur's Handbook," since an aerial coupler not only ensures the most efficient transfer of power from transmitter to transmission line, but also has a beneficial effect on the radiation of harmonics. The question of harmonic radiation is quite an important one, because while the second harmonic of a transmitter on the 80m. band may fall into the 40m. band, it may not, and in either case it can be a source of annoyance to others. In particular, it will annoy the officials of the P. and T. Department, who will rightly have grave words to say to the perpetrator of signals outside the amateur bands. The use of an aerial coupler can reduce very greatly the harmonic radiation from the transmitter. It is partly for this reason, too, that the L/C ratio of the final tank circuit is carefully specified. The transmitter will certainly work with other values of inductance in the final tank, but it will not be efficient, nor will it suppress harmonics so well. Many beginners fall into the mistaken notion that as long as the tank circuit tunes to frequency, the tank coil consists of 15 turns of 16-gauge tinned copper wire, wound on a 2 in. diameter former. The coupling link is three turns of the same wire, wound to the same diameter. The tuning condenser has been specified as 250 $\mu\mu$f., and will tune to the lower end of the 80m. band at almost full capacity, when used with this coil.

Unfortunately, small transmitting variable condensers are a bit difficult to come by at the present time, and most receiving variables these days have much too little spacing between plates to use in a transmitter, since the high voltages involved will be likely to flash over. In the case of the prototype transmitter, we had to use a 60 $\mu\mu$f. variable condenser taken from an SCR522 transmitter, and to pad it up with a 100 $\mu\mu$f. fixed condenser in parallel. This is perfectly satisfactory, provided one does not use a small receiving-type fixed condenser. The one used was a 600-volt working transmitting-type mica condenser, which was found to stand up to the job very well. It should be pointed out that as long as the required maximum capacity is made up somehow, with condensers that will stand up to the working conditions, the values of the fixed and variable portions are unimportant. Even a 50 $\mu\mu$f. variable, with a 200 $\mu\mu$f. fixed condenser will be quite satisfactory, and will give enough variation to enable the 80m. band to be covered by the variable position. There is plenty of room on the right-hand end of the chassis, so that even if a variable that is much larger physically than the one shown has to be used, it should not cause undue difficulty.

Another feature that is of some importance is the use of shunt feed in the plate circuit of the final. In the first place, it removes the D.C. plate voltage from the variable condenser and also from the coil, so that it will not be possible to get a shock from the H.T. line if the coil is accidentally touched while the transmitter is on. A technical advantage of so doing, however, is that as the D.C. plate voltage has been removed from the tank condenser, only R.F. voltage appears on it. This reduces the total maximum voltage to about a half of what would appear across the condenser if the rotor was earthed, and the stator was connected directly to the final's plate. Another way of reducing the voltage across the condenser, while using series feed, is to connect the rotor to the H.T. line instead of to earth. This means insulating the whole of the condenser from earth, however, and still leaves the H.T. voltage on the tank circuit as a danger to unwary fingers.

In series with the plate lead of the final, and connected right at the plate is a 25-ohm stopper resistor. In case there should be a temptation to leave this out, its purpose should be explained. Without it everything worked very well, except that with the key up, a very small grid current was still apparent in the final amplifier. This was only about 0.1ma., but its presence indicated the existence of some spurious oscillation, or parasitic. Test showed it to be taking place at some very high frequency, but the insertion of the plate stopper cured it completely.It was connected right at the insulted plate cap of the tube, and a piece of sphagetti placed over it to conceal the joint between it and the lead wire. It just shows on the photograph as a slight extension of the insulated cap.

CONSTRUCTION

While the photographs and chassis diagram give a good idea of the general lay-out and construction, there are some points that require clarifying and emphasizing. The chassis used was a commercially available one measuring $11\frac{1}{2}$ x $7\frac{1}{2}$ in. It had a strip of tinned steel welded down the centre inside, and protected with cellulose tape from becoming sprayed with paint. When received, the tape is still in position, and stripping it off reveals the nice clean tinned strip which makes an excellent earthing medium—much better than can be obtained by boring a hole and mounting an earth lug with a nut and bolt, at every point where an earth connection is required. However, if this kind of chassis is not available, or if you make your own, earth lugs will have to be provided, but as long as care is taken to scrape the paint from the spot where the lug is to be installed, so that it makes a good metallic contact with the chassis, all will be well.

Looking at the under-chassis picture, the crystal socket can be seen at the left-hand top one of the four, which are arranged at the corners of a square. The Rimlock socket immediately below it is that of the oscillator valve. Then, the remaining 5-pin ceramic socket is that of the final amplifier, with the other Rimlock socket for the screen-protecting EL42. The large wire-wound resistor running lengthwise is the 25k. voltage divider. At the left of the chassis, every component of the oscillator circuit can be identified quite readily. The sockets are spaced just far enough apart for the coupling condenser between the oscillator plate and the final grid to be hung neatly between the two valve pins concerned. This condenser is the tubular ceramic one which runs parallel with the back of the chassis. We have mentioned this in detail, because it gives a clue to the way in which the oscillator socket should be oriented to give the shortest connections. The other tubular ceramic condenser attached to the oscillator socket is the 200 $\mu\mu$f. one between the plate and the crystal. Note, too, the insulated terminal lug that is mounted on one of the socket mounting bolts, and to which the H.T. end of the oscillator plate choke is connected. The postage-stamp 0.002 μf. mica condenser is connected close up to the screen terminal on the oscillator socket, and a short wire is run from the R.F. choke to the screen pin, to complete the plate circuit, and a wire is run from the same pin right round the chassis to the keying jack, from which a lead goes to the tap on the voltage divider. We mention all this to illustrate one of the cardinal principles of R.F. wiring, in both receivers and transmitters. The bypass

condenser is put as close to the point to be bypassed as possible, namely right at the screen terminal. The short lead from the R.F. choke is unimportant, because if the latter is doing its stuff, there should be only a very small R.F. voltage at the H.T. end of it. In this way, all the oscillator's R.F. plate current is confined to the immediate vicinity of the valve itself. This having been done, we can legitimately regard the lead from the screen pin to the power supply as being completely devoid of R.F., and carrying only D.C. This being the case, it can take as long a path as we please to the source of H.T., so we run it thence by a route as far removed from the remainder of the R.F. circuit as possible, to prevent it from picking up R.F. on the way, or from causing unpredictable and undesired coupling between two other parts of the circuit. Several other long leads can be seen, notably those to the plate and grid current jacks. These have all been treated in the same way, by placing bypass condensers right at the points to be bypassed, just as has been drawn on the circuit diagram.

There is only one lead carrying R.F. in the whole transmitter. This is the plate lead from the top-cap of the QE06/50 to the tank circuit. At the frequency used, however, this length of lead is unimportant, provided that it cannot cause undesired coupling to other parts of the circuit. In this case it cannot, because the whole of the rest of the circuit is under the chassis, with the exception of the oscillator valve. As this is well shielded internally, the final plate lead will not cause trouble. In practice it has not been found to do so. The plate lead goes straight down through the chassis, via a rubber grommet, and terminates on a small stand-off insulator, which can be recognized in the photograph, just in front of the power socket on the back of the chassis. From this stand-off are taken the 0.002 μf. blocking condenser, the other end of which terminates on a small feed-through insulator. The latter brings the connection through the chassis, to the stator of the variable condenser. Thus, the only parts above the chassis are the coil and tuning condenser. The coupling link is there too, of course, mounted on a pair of small stand-off insulators. The main coil is also mounted on these, and a stiff wire is taken from the stator on the condenser to the back end of the coil, which is the "hot" end. The fixed portion of the tuning capacity can just be seen in the top view. It is the dark object behind the coil, and is connected between the frame of the variable and the wire which goes to the coil from the stator.

POWER SUPPLY

The power supply for the transmitter is nothing more than a conventional full-wave rectified one with condenser-input filter, and delivers just over the specified 400 volts, at enough current to operate the transmitter on C.W. For 'phone operation, a modulator will be required with its own separate power supply, and succeeding instalments will describe the circuits needed. Our next job, however, is to describe the setting up and operation of the transmitter on C.W.

(To be continued)

BOOK REVIEWS

(Continued from page 27)

business of producing saw-tooth current waveforms. There is the usual explanation of the "peaking resistor," whose function is allegedly to provide the composite saw-tooth-cum-pulse waveform of voltage which must appear across the terminals of the deflection coils if a saw-tooth wave of current is flowing in them The authors do not make plain, however, that this same waveform is needed at the grid of the time-base, output amplifier only in the case where this is a triode, or constant voltage generator, or that when a pentode is used in this position, it can be regarded as a current generator, in which case its grid waveform should in theory be a pure-saw-tooth. Admittedly, this is one of the most difficult explanations to "get over" to the newcomer to TV, for various reasons, but it is also one of the most important, and almost any amount of space devoted to it can be regarded as well spent, provided it tells the whole story. For instance, on the page in which the circuits of a line and a field time-base amplifier are shown together, the input waveforms in the two cases are shown identical in both shape and size. This is misleading in two ways. First it ignores altogether the fact that while the mechanism in the two cases is theoretically indentical, the waveforms obtained in practice are quite different, owing to the different relative importance of the resistive and reactive components of the scanning coil impedance in two cases. Secondly, it leaves the beginner to supply for himself the fact that the waveforms must be very much out of scale on the time axis. For the experienced reader this would not matter, but for the inexperienced one it does, a great deal. We are afraid that in this instance, the authors have sidestepped a difficult issue.

However, this criticism should not be taken as a detraction from the book as a whole. It is, on the whole, well written and clear in exposition, and can well be recommended as a first text for the aspiring TV technician. Not only this, but he will find it easy to read and to assimilate.

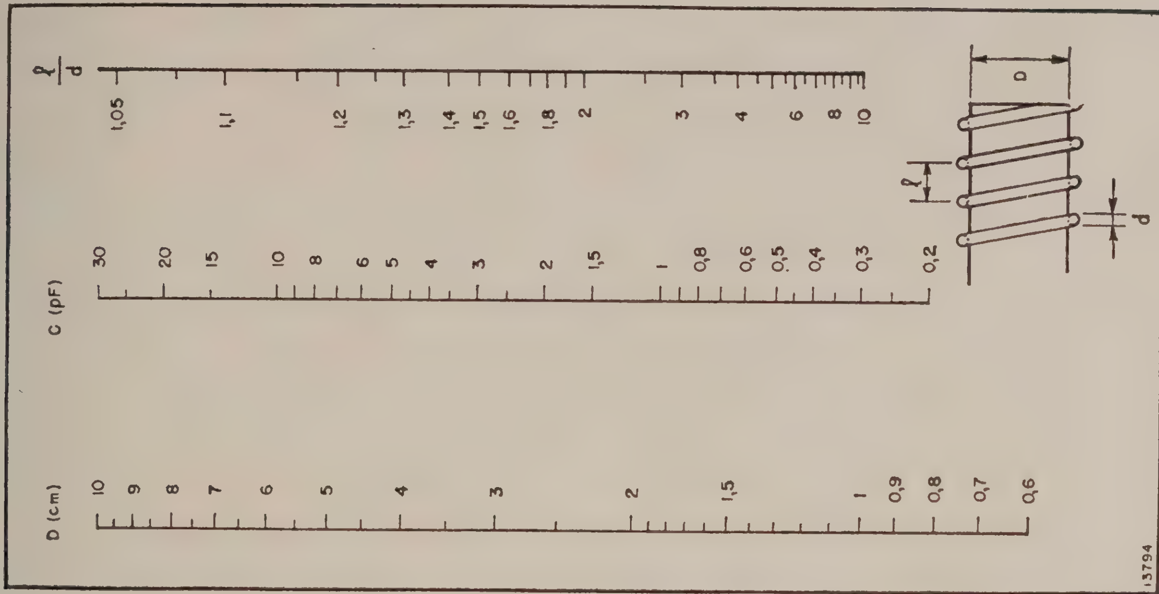
INDUCTANCE OF SINGLE-LAYER COILS

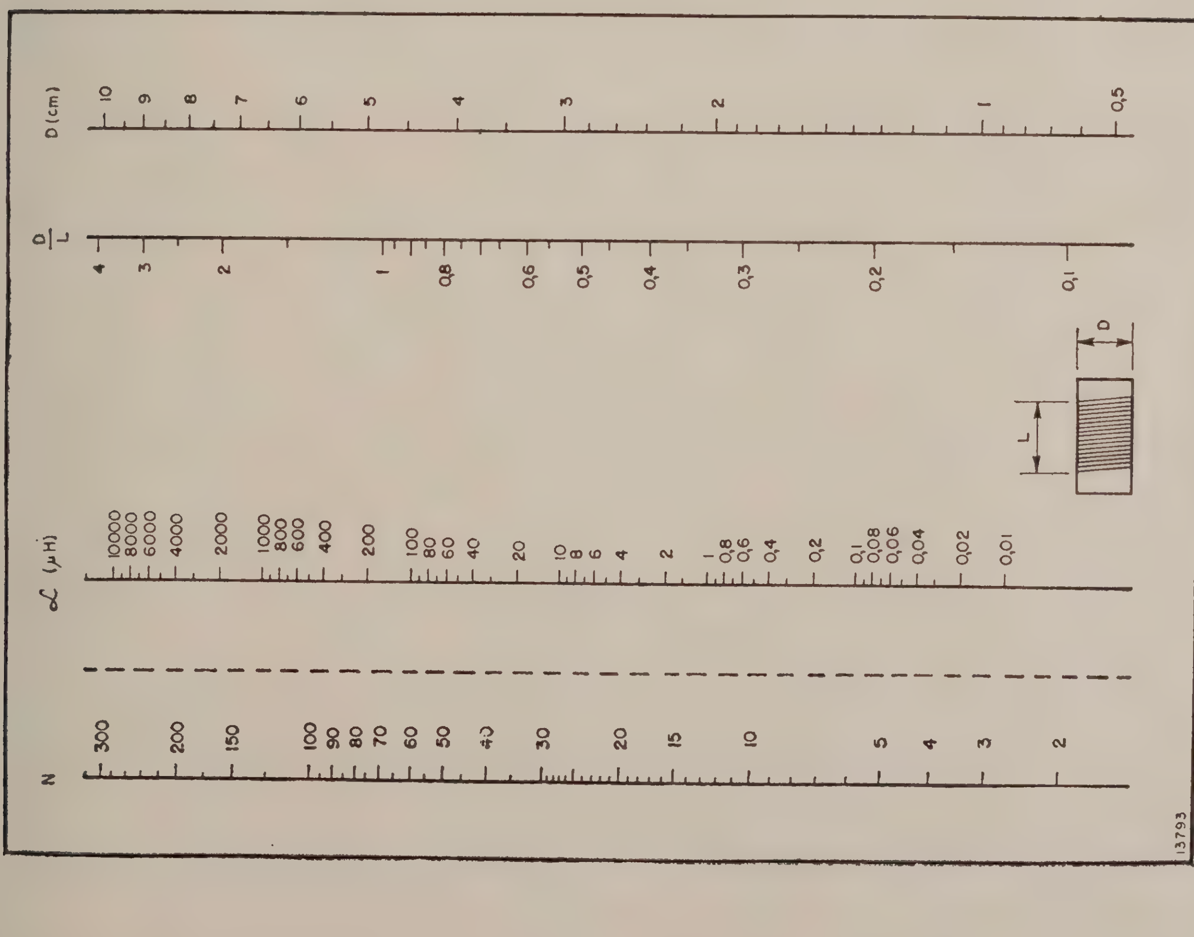
The large chart on page 33, opposite, is an excellent one for those who have to wind single-layer coils to a given inductance. The required inductance will first have been found from the formula for inductance, capacity and frequency, or by the use of a chart connecting the three, such as is found in "Radio Data Charts," by Beatty and Sowerby. The diameter of the former it is proposed to use will have been decided, and it remains to find the required number of turns, and the turn spacing, to give the required inductance. This is done from the chart in two steps. First, a ruler is placed between the diameter D, on the right of the chart, and the required inductance in microhenries. The line joining the two values is marked where it cuts the dotted reference line. The ruler is then taken from the value of D/L, to the point already found on the reference line, and where the ruler now cuts the left-hand scale, the required number of turns is read off.

As an example, suppose we have a half-inch diameter former, and have to wind a coil of 10 micro-henries inductance. Now the diameter scale is in centimetres, so that our diameter in inches will have to be converted to centimetres before we can use the chart. One inch equals 2.54 cm., so that half an inch is 1.27 cm. This figure is joined to the 10 μH mark on the inductance scale, and the intersection with the reference line is noted. Suppose we want the winding length to be 1 in. This makes D/L equal to 0.5, and joining this figure on the D/L scale to the marked place on the reference line, we find that 42 turns are needed. Further details we can work out for ourselves. For example, if we want a close-wound coil, we will have to use wire that winds up at 42 turns to the inch, but if we want double spacing, we must use wire that goes 84 turns per inch, The wire tables will thus tell us what wire-size to use.

The second chart is for finding the self-capacity of a given coil, and is self-explanatory. The D scale is joined to the 1/d scale, at the appropriate points, and the value of C is read off where the ruler cuts the C scale.

There is an advantage in a chart like this one which uses centimetres instead of inches for the coil diameter, since most of the charts designed for use with inches do not have enough graduations to indicate accurately diameters between the stock values of 1 in., 1½ in., 2 in., etc. If inches are converted to centimetres, and this chart used, quite accurate results will be obtained, and the users will be surprised how accurately the required inductances are obtained when actually built, following the chart.


l/d
C (pF)
D (cm)
D
l
d
13794


D (cm)
D/L
ℒ (μH)
N
L
D
13793

Ultra-high Frequencies

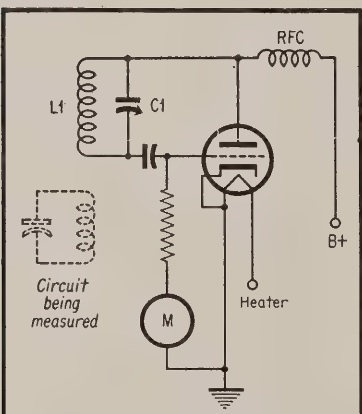
U.H.F Instrumentation—Part 2: A U.H.F. Grid-Dip Oscillator

(By the Engineering Department, Aerovox Corporation)

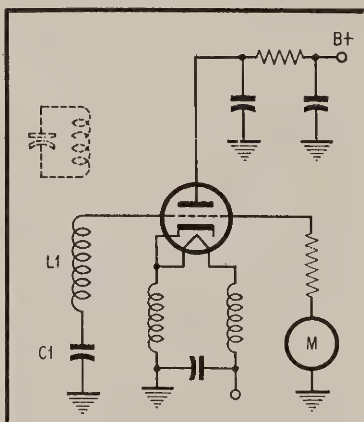
In "Radio and Electronics" Vol. 8, No. 2, April 1953 we discussed the need for simple, economical measuring instruments for use by the experimenter, service technician, and amateur working in the rapidly expanding ultra high frequency region.

The U.H.F. absorption frequency meter described in the above mentioned issue fulfills the first need for an instrument to determine the frequency of a signal source operating in the vicinity of the channels 470-890 mc. Thus, the tuning range of the local oscillator of a U.H.F. television converter could be measured and adjusted. Another need, however, which is not satisfied by the absorption meter, is that of determining the resonant frequency of passive circuits which are not generators of energy. Such an instrument permits measurement of the frequency of resonance of U.H.F. converter preselectors, mixers, wavetraps, and oscillator or amplifier "tanks" with all power removed. This need can be fulfilled by a U.H.F. adaption of the popular grid-dip oscillator. The design and construction of an experimental instrument of this kind is the subject of this issue.

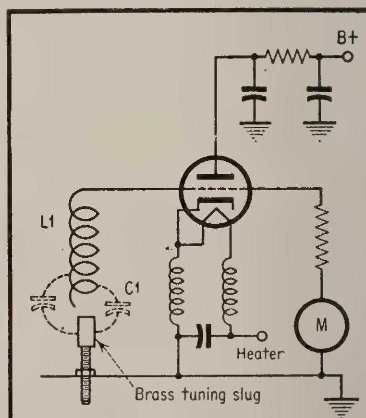
type is brought close to another circuit which is tuned to the same frequency, some of the r.f. energy in the oscillating tank circuit will be absorbed. The result is a sharp decrease, or "dip," in the rectified grid current. This happens since the removal of some of the oscillator energy reduces the amount of feedback drive available to the grid. The plate current undergoes an increase at the same time due to the increased oscillator loading. The grid dip is sharper, however, since a cumulative effect occurs; a decrease in the r.f. energy in the tank, caused by absorption, results in less feed-back drive on the grid, which decreases the output and, hence, reduces the grid drive still further. Therefore, a sensitive indication of resonance in a nearby circuit is provided. If the grid-dip oscillator is calibrated in terms of frequency or wavelength, the frequency or wavelength of the circuit being measured is then known by the point at which absorption takes place. The accuracy is maximum when the coupling between the grid-dip meter and the circuit of unknown frequency is the least which will produce a readable "dip."



SIMPLE GRID-DIP OSCILLATOR CIRCUIT
FIG.1



SERIES-TUNED UHF OSCILLATOR
FIG.2



SLUG-TUNED SERIES-RESONANT UHF CIRCUIT
FIG.3

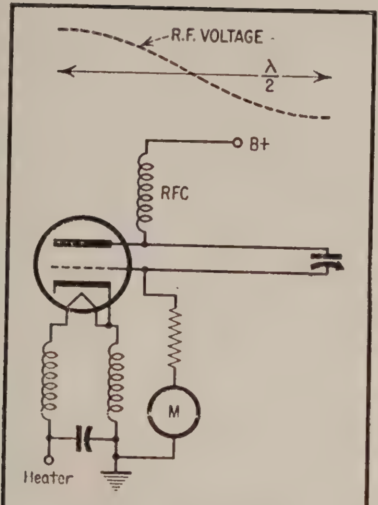
Basically, the grid-dip meter is a simple self-excited oscillator capable of continuous tuning over the range of frequencies of interest and provided with a metering arrangement in the grid circuit to measure grid excitation. These conditions are met by the simple ultra-audion circuit of Fig. 1. In this circuit the grid and plate of the vacuum tube are connected to opposite ends of the resonant circuit L1, C1. In this way, part of the energy in the resonant circuit is fed back to the grid in the correct phase to maintain oscillation. This r.f. feedback swings the grid positive, so that the grid draws current. The meter (M) reads the rectified grid current, which is a measure of the r.f energy in the "tank" circuit.

Now, if the resonant circuit of an oscillator of this

U.H.F. DESIGN CONSIDERATIONS

Although the design of a grid-dip oscillator for low frequency usage is a relatively straightforward undertaking, producing one for the use in the new U.H.F. TV channels is considerably more difficult. This is partially because, as stated before in these pages, the new channels lie in the "transition" portion of the radio-frequency spectrum where the frequency is "too low for cavity circuits and too high for coil and condenser circuits." It is difficult also because of the special requirements of a grid-dip oscillator which must:

(a) Oscillate smoothly over at least the frequency range extending from 470 to 890 megacycles.



HALF-WAVE LINE
UHF OSCILLATOR CIRCUIT
FIG.4

(b) Have sufficient stability to prevent frequency "pulling" by the circuit being measured.

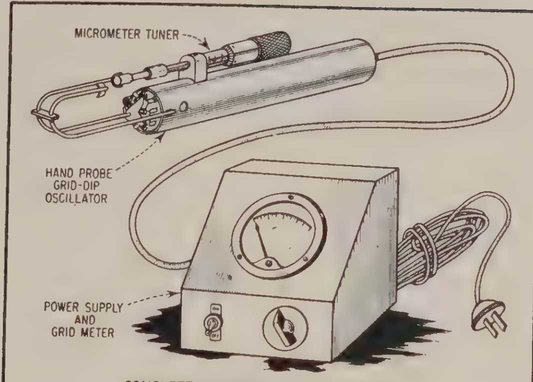
(c) Have a compact form factor suitable for hand probing in limited space.

(d) Have a resonant circuit configuration which affords easy inductive coupling to external circuits.

(e) Be easy to construct with a minimum of machine work.

The best place to look for a type of self-excited oscillator to fulfill these requirements is among those which have been developed for U.H.F. television local oscillators. Unfortunately, the field is limited to a few types, since many manufacturers have utilized the harmonics of oscillators operating at lower frequencies. The U.H.F. tuner circuits which have proven successful for fundamental frequency operation are the butterfly, the semi-butterfly, the split-ring, the series tuned circuits, and various forms of transmission line tuned oscillators. The first three of these was illustrated and discussed in Part 1 of this series. We will now consider the applicability of these various kinds to the grid-dip application problem at hand.

The split-ring, or split-cylinder tuner, now widely used in TV converters could be used for grid-dip oscillator purposes although its form-factor is not ideal in its usual form. For a hand-held oscillator it would be somewhat bulky and difficult to conveniently tune. Experimental split-ring oscillators were tried using this kind of tuner modified and as the absorption frequency meter described in Part 1. It was hoped that the entire oscillator could be constructed within the tubular handle which forms the basis of the split-cylinder tuner. A grid-dip oscillator having an ideal factor would result. However, it was found that the addition of the tube interelectrode capacitance to the resonator circuit lowered the upper frequency attainable. To compensate for this effect, a smaller diameter cylinder would have to be



COMPLETED GRID-DIP METER FOR UHF TV
FIG.5

used, precluding the possibility of enclosing the tube and other oscillator parts within the handle.

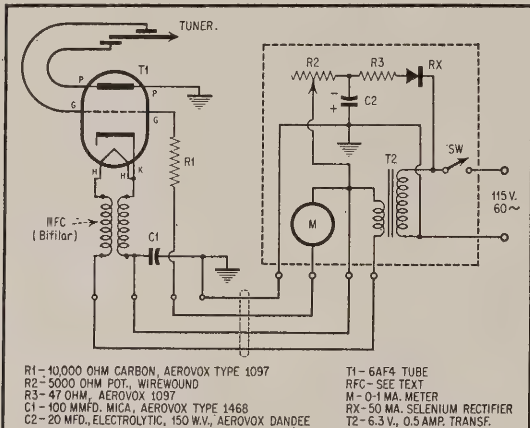
The butterfly tuners have the disadvantage of being difficult to construct and are somewhat bulky for this frequency range. The semi-butterfly tuner is easier to construct than the full butterfly, but has a poor configuration for our purpose and tunes rapidly with shaft rotation, making reading difficult. Being a single-ended parallel resonant circuit, it too, is considerably foreshortened by the tube capacitance.

Series tuned local oscillator circuits, such as that illustrated in Fig. 2, do not easily cover the frequency range required unless a tapped coil is used. Accurate calibration then becomes difficult to maintain. A special form of the series-tuned oscillator, in which the effective length of the coil is changed during tuning by a grounded metal slug which slides inside the coil in such a manner as to move the ground point progressively higher and so reduce the inductance, is shown in Fig. 3. Although it is being used to some extent in U.H.F. local oscillator service, attempts to adapt it to a grid-dip meter were not successful because the required tuning range could not be covered in a structure capable of easy construction.

The oscillator type finally adopted is the self-wave parallel line circuit of Fig 4. In this arrangement, the more usual shorted quarter-wavelength line is replaced by an open-circuited, half-wavelength line connected between the grid and plate of the oscillator tube. This provides a greater length of line external to the tube than the quarter-wave circuit does, facilitating coupling to the circuit being measured. An oscillator of this kind can be tuned by a variable capacitance located at the end of the grid-plate line. A voltage maximum point exists at this point as well as at the other end where the tube electrodes are connected. This voltage distribution is indicated in Fig. 4 as a dotted line. The zero-voltage point moves along the line during tuning, being in the centre when the capacitance of the tuner is equal to the capacities of the tube elements and socket combined. At the high frequency end of the tuning range, the modal point may be within the tube envelope.

By careful design and construction, the oscillator of Fig. 4 can be made to operate smoothly over the U.H.F. TV range. It requires so few parts that the entire oscillator can be used as a hand probe, held and tuned by one hand. To render the line circuit

more compact, the line is folded to form a "U" so that the capacitive tuner is close to the tube. The curved portion of the "U" then serves as an inductive loop to couple the grid-dip meter to the circuit being measured. The tube employed is the 6AF4 miniature now popular in U.H.F. converters. Radio frequency chokes are used in the heater-cathode leads to maintain the entire cathode structure above r.f. ground.



EXPERIMENTAL UHF GRID-DIP OSCILLATOR CIRCUIT
FIG. 6

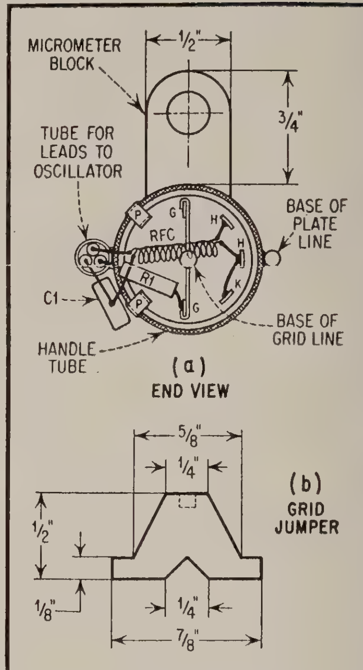
The dip-indicating meter and the power supply required for the oscillator are housed in a separate unit with flexible interconnecting cable. For convenience in the construction of the oscillator, the anode is operated at D.C. ground potential and the cathode at negative 100 volts. For this reason, the power supply is connected for positive-grounded output.

CONSTRUCTION

The completed experimental grid-dip oscillator and supply are shown in Fig. 5 and the corresponding electrical circuit is given in Fig 6. It must be stated here that, because of the critical nature of U.H.F. circuitry, satisfactory results can only be expected if the details of the oscillator construction are closely followed. Most of the operations involved in making the unit can be performed with hand tools, although several parts should be lathe turned if possible.

The oscillator unit is built in the end of a piece of standard brass tubing $\frac{7}{8}$ in. o. d. and 5 in. long. This tube forms the handle of the grid-dip probe. The 6AF4 oscillator tube mounts inside this tube with its socket terminals about flush with the end. A high quality ceramic miniature tube socket of the type having a metal shield base will fit snugly inside the brass tube if the mounting "ears" and small "nubs" designed to engage the shield are filed off. The metal detail through the centre of the socket is also removed. To facilitate insertion and removal of the 6AF4, a $\frac{1}{4}$ in. hole is drilled through the wall of the brass tube to coincide with one of the holes in the shield base. This allows the blade of a small screw-driver to be inserted between the tube base and socket to disengage the tube for removal.

Fig. 7a illustrates the end-view layout of the oscillator end of the brass tube with the relative positions of the parts and terminals. The two plate



SHOWING DETAILS OF OSCILLATOR CONSTRUCTION
FIG. 7

terminals of the tube socket are soldered to the inner surface of the handle tube at the nearest points. The grid terminals are tied together by a piece of sheet copper or brass about .015 in. thick and cut to the shape indicated in Fig. 7b. The tabs on the end are crimped around the socket terminals and soldered. Crimping provides a firm mechanical attachment which will hold the grid jumper in place even though the solder is re-melted in subsequent soldering operations.

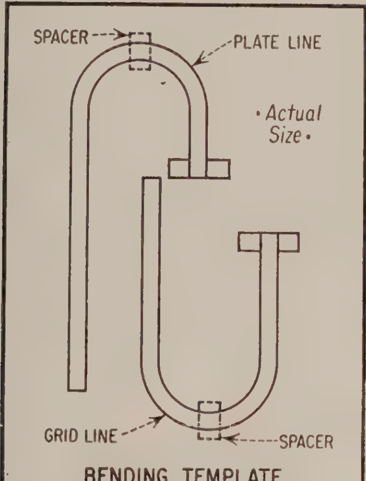
Since the 6AF4 and socket fill the entire diameter of the handle tube, the leads to the oscillator must be run along the outside. For this purpose, a piece of $\frac{1}{4}$ in. o. d. brass or copper tubing is soldered along the length of the large tube at the location shown in Fig. 7a. A strip along the length of each tube is liberally tinned with solder before the two pieces are "sweated" together with a hot iron.

The construction of the r.f. chokes for the heater-cathode circuit of the grid-dip oscillator is critical. If the cathode lead inductance is not the proper value, the oscillator will exhibit "holes" in the tuning range which make its use for determining the frequency of other circuits difficult, since the tuning "holes" also result in dips in grid current. A satisfactory choke system is made by winding both coils simultaneously with No. 22 enamelled wire on the shank of a No. 32 twist drill (.116 in.). This bifilar winding is made self-supporting after the removal of the drill by twisting the ends of the wires together for a distance of $\frac{1}{4}$ in. on both ends of the required 12 close-wound double turns. The wound part of the choke is $\frac{1}{2}$ in. long and it mounts against the ceramic socket in the space between the two

plate terminals and between the two grid terminals.

The grid-plate line circuit is made of No. 12 B&S gauge tinned copper.

The plate wire is 3 in. long and the grid wire is $2\frac{3}{4}$ in. long. These wires are bent to form a "U" according to the actual-size template given in Fig. 8. The grid line is $\frac{1}{4}$ in. longer at the tuner end of the line and the plate line overlaps $\frac{1}{2}$ in. at the tube end; $\frac{1}{4}$ in. of this is soldered to the surface of the handle tube at the location indicated in Fig. 7a. The tube end of the grid line is soldered to the centre of the sheet metal jumper made to tie the grid



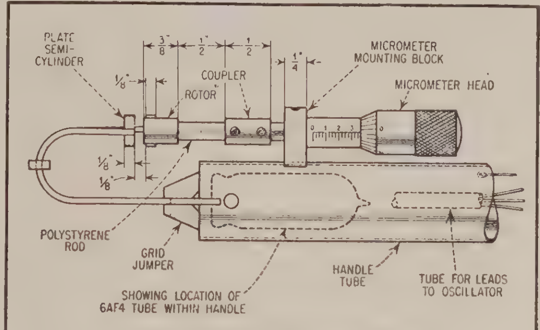
BENDING TEMPLATE FOR GRID-PLATE LINES
FIG.8

terminals together. A neater connection will result if the grid wire is slotted with a small saw for about $\frac{1}{8}$ in. so that it will fit around the jumper.

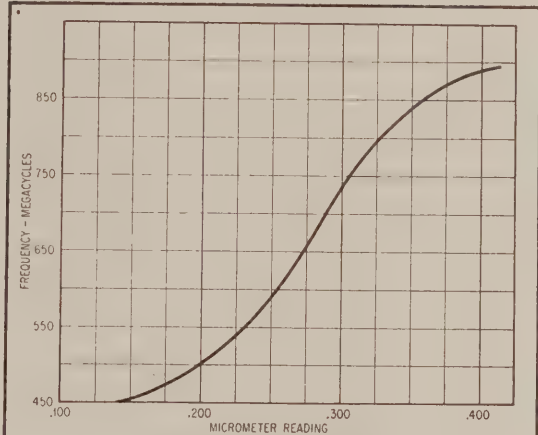
A dielectric spacer is used to maintain the proper spacing between the grid-plate lines. It consists of a $\frac{1}{4}$ in. x $\frac{1}{4}$ in. x $\frac{3}{4}$ in. polystyrene bar drilled on $\frac{3}{8}$ in. centres with holes just large enough to admit the line wires (No. 38 drill). This spacer may then be fixed firmly at the proper location indicated in Fig. 8 by liberally tinning the wires at that point and sliding the spacer quickly into place while the solder is still molten. The spacing between the wires should be $\frac{3}{8}$ in. except at the tuner end when they spread to $\frac{1}{2}$ in.

The capacitative tuner for the grid-dip oscillator is made by soldering small semi-cylindrical plates to the ends of the grid and plate line. The one on the plate line becomes the stator of the tuning capacitor, while the one on the grid wire acts as a wiper against the rotor. The rotor consists of a short cylinder of brass tubing which is driven longitudinally to engage the stator sections by a micrometer head drive mounted on the handle tube. The micrometer head, which may be of the chain-store variety, provides a precisely readable calibrated drive which can be manipulated smoothly with the thumb of the hand holding the meter.

The details of the capacitor tuner are shown in Fig. 9. Since the builder will probably have to utilize whatever micrometer head is readily available, and the exact duplication of this detail is not necessary, dimensions determined by the drive used will be left to the builder to determine. The micrometer head is mounted on the side of the handle tube at the angular position shown in Fig. 7a. This is accomplished with a brass block, as shown in Fig. 9, which



DETAILS OF MICROMETER TUNING SYSTEM
FIG.9



TYPICAL OSCILLATOR CALIBRATION
FIG. 10

is drilled with a hole of the proper size to fit the stationary barrel of the micrometer and fitted with a set-screw to lock it in place. The bottom of the block is filed to the proper contour to fit the handle tube and is "sweated" in place.

The tuner rotor, made from brass tube stock $\frac{1}{4}$ in. i. d., 5/16 in. o.d., and $\frac{3}{8}$ in. long, is pressed onto a $\frac{1}{4}$ in. polystyrene shaft. This "poly" shaft, in turn, is coupled to the micrometer shaft by means of a rigid shaft coupler, The coupler must fit well enough to make the rotor run true when the micrometer drive is revolved. If the micrometer shaft used is not of the proper diameter to fit a standard coupler, one should be lathe turned.

The stationary tuner plates are made from $\frac{3}{8}$ in. o. d. brass tube stock sawed lengthwise to form semi-cylinders $\frac{1}{8}$ in. long. These are soldered to the ends of the grid-plate lines concentrically so that the rotor cylinder will move smoothly through them. The semi-cylinders are $\frac{1}{8}$ in. apart. They can be best aligned by soldering them in place while the rotor is engaged providing all parts are pre-tinned to prevent

the heat of soldering from softening the polystyrene shaft. After the plates are soldered in place, the spacing of the line is adjusted so that the grid plate makes a smooth wiping contact on the rotor, while the semi-cylinder on the plate line is carefully spaced only a few thousandths of an inch from the rotor cylinder. This adjustment is critical if the full U.H.F. TV range is to be spanned. Air insulation is used between the stator and rotor if the latter has no "wobble" so that close spacing can be maintained without shorting. If not, a thin sheet of a high quality dielectric should be cemented to the inside surface of the plate cylinder. A piece of "pliofilm" of the kind used by grocers for vegetable bags was found to have sufficiently low losses for this purpose. Cellophane was found excessively lossy.

The length of the polystyrene rod is adjusted to allow the rotor to be moved from a position where its end is flush with the far side of the grid wiper cylinder (high frequency end of tuning range), to a position where it is fully engaged with both cylinders and its end is flush with the far side of the plate cylinder (low frequency position). If good alignment and close tuner spacing is maintained, the resulting tuning characteristic will be similar to Fig. 10. The finished meter should be calibrated against a frequency standard such as a Lecher line. The absorption meter described in Part 1 of this series is an ideal tool for use in adjusting the tuning range of the grid-dip oscillator, After adjustment, the oscillator must be handled carefully to prevent disturbing the calibration.

USING THE GRID DIP METER

The use of the experimental grid-dip meter for U.H.F. is identical to that of the low frequency versions. The plate voltage on the 6AF4 tube is adjusted (R2) until the grid meter indicates that the tube is oscillating and drawing between one-quarter and three-quarters milliamperes grid current. (The corresponding plate current must not exceed 16 milliamperes.) The bent portion of the grid-plate line is then brought close to the circuit of unknown frequency and the micrometer tuner is run through its range. There will be a sharp dip in grid current at the frequency of the circuit being measured. A little practice with a resonant circuit of known frequency will acquaint the user with the position for optimum coupling.

Needless to say, the grid-dip oscillator can also be used for a calibrated test oscillator, a rough "Q" meter, and many of the other uses which have been found for the versatile grid-dip oscillator at lower frequencies.

On the Air with the Hams

Mr. R. S. Pottinger, ZL4GP, of Burnside, inaugurated the "transistor age" with N.Z. Hams recently, when he established morse contact with Mr. A. F. Frame, ZL4GA of Tainui, using a transmitter incorporating one of the four transistors specially imported from England for experimental work.

Within a few moments of Mr. Frame's general call to all stations on the 80-metre band to listen for Mr. Pottinger's transmissions, favourable reports were received from all over New Zealand, including distant Whangarei.

Already, the transistor, that amazingly simple device capable of performing efficiently nearly all the functions of an ordinary vacuum valve, has wrought many changes in the fields of electronics and electrical communication. Of minute size, being housed in a cylinder less than one inch long, the transistor actually consumes less power than a tenth of that used by a flashlight bulb. Though still very much in its infancy, the transistor, invented by the Bell Telephone Laboratories of America in 1948, is now extensively used in America for automatic routing and connecting of telephone calls through exchanges, and in accounting and computing machines and other forms of "electronic brains."

Guests of honour at companion functions held in Buenos Aires and Gisborne recently were Senor Charles Braggio, Argentina and Mr. I. H. O'Meara of Gisborne. The celebration was the thirty-first anniversary of that great event on 22nd May, 1923, when 7,500 miles away, Mr. O'Meara picked up Senor Braggio's signals and answered them, receiving in turn an acknowledgement of his calls.

Though this transmission was followed by many others more technically perfect, it broke into a virgin field of experimentation and research, preceding by at least two years the recognition of short wave radio by any but the most advanced of Government agencies throughout the world.

Other pioneer experimenters included Mr. J. Bingham of the Public Works Department, Gisborne, and later chief engineer to the first commercial broadcasting venture in New Zealand, and Messrs. P. R. Stevens and R. J. Patty, who were active partners in the sustained effort over many years to make the most of the wave lengths allotted to amateurs.

Automatic Radio System For Press Messages

Latest means of keeping New Zealand in rapid touch with world events is the radio teleprinter service between Sydney and Wellington arranged by the Post Office for the New Zealand Press Association. Inaugurated on 17th May last, this new circuit not only provides more rapid transmission from Australia, but also contributes to faster communication from London and New York, the major clearing centres for world news.

Though, for many years the Post Office has handled traffic including press messages, by using various forms of radio telegraphy, this new service is the first regular one employing a radio-teleprinter as a direct link for passing world news to newspapers throughout the Dominion.

Routed from Sydney by landline to the Overseas Telecommunications Commission (Australia) radio station at Pennant Hills, the signal is received by the New Zealand Post Office Station at Makara, from thence passing by landline to the telegraph room in Wellington. Here the signals, caused by the perforated tape running through the Sydney transmitter, are automatically converted back into the printed word on a teleprinter. Not only does this instrument produce a neat page copy, but simultaneously it perforates a new tape which can be fed into the press teleprinter network operated by the Post Office for the Press Association, servicing all main daily papers in the Dominion.

In spite of the delicate and valuable equipment used, the relay of the signal from transmitter to receiving teleprinter is fully automatic, though, of course, the whole operation is supervised by skilled engineers and technicians. By means of perforations on the new tape as the message is printed, the message can be sent throughout the North and South Islands without an operator needing to repunch it.

Much of the news reaching New Zealand over the new channel is sent to Australia by radio from London and New York. In some instances, therefore, the use of reperforated tapes in Melbourne and Sydney enables the news from New York to reach Whangarei and Invercargill, for example, without being repunched on a keyboard by a telegraphist at any point. The signal first punched in New York can print the news at up to 66 words a minute on teleprinters in newspaper offices throughout the Dominion

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Unfreeze With Refrigerators

(By Janus)

As more and more families in New Zealand are demanding household refrigerators and home freezers, the selling and servicing of this equipment is becoming a big and ever expanding business. Are you getting your fair share of these lucrative and desirable sales? Is your business attracting customers and gaining goodwill from the sale and servicing of refrigerators and freezers? If you have not yet climbed on the "band-waggon," why not?

In country and semi-urban areas, a refrigerator is essential and a home freezer desirable. No country housewife will deny that these pair save money and soon pay for themselves. In the town, by the saving of otherwise wasted foodstuffs, a refrigerator not only represents a reduction in the cost of living but is also a social asset.

If you are "right on the ball," you do not need to be told these things, but are you selling all the refrigerators and home freezers your community requires. How many jugs, toasters, kettles, etc., must you sell to equal the sale of one refrigerator? Such is the demand for the latter that they tend to sell themselves. Cynosure of all eyes in your showroom, a refrigerator represents quick and effortless turnover. What then, the results of an active sales campaign?

To sell any commodity successfully, the salesman must be able to answer three basic questions:

(a) What are its uses?

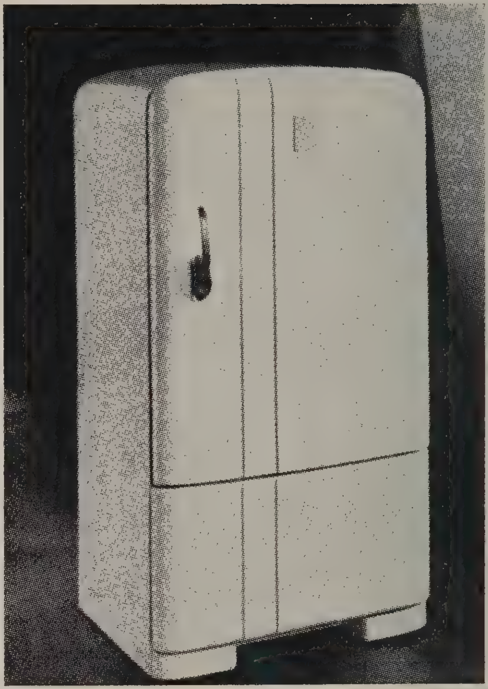
(b) How does it work?

(c) Why own it?

Superficially you know the answers to these, but are there any points a customer might ask which you cannot fully answer? Taking refrigerators as an example, let us consider each of these questions in turn.

What does a refrigerator do?

Sure, it gets cold, and in that way helps to preserve food. Is that a full answer? No! Firstly, why is it necessary to preserve food. The butcher's shop is just around the corner, and the dairy gives good service. Is the saving of left-overs such a large economic item with an efficient housewife? In summer, does a good housewife lose such a quantity of perishable food that she can economically justify the purchase of a fairly sizeable article such as this? The answer is doubtful, so a more positive approach is necessary. Can you explain to her the saving to be gained from local resources by the purchase of meat in bulk—half a side of lamb, instead of half a dozen chops, a shoulder and then the leg? Do you know the reduction in wastage in the cooking of one large roast as against two small roasts? Does a cauliflower of twice the size cost twice as much? Give a prospective customer the answers that strike directly into the pocket, and you are well on the way to a sale. What is the price of convenience? Does the home mother have to stay in to cook a roast because it is not keeping? What monetary value can be put on long week-ends with freedom



from worry over suitable meals? On the housekeeping side, your prospective customer is only too well aware of her difficulties. It is up to you to show the relief she can gain. Point these things out in their true perspective.

Why not "scout around" and learn the answers to these questions so that you really can convince your customer of the advantages she will gain from the purchase of a refrigerator.

How a refrigerator works:

This is not the place for an involved discussion on the principles of refrigeration, but you must have some idea of those on which a refrigerator works to enable you to cope with the prospective customer interested in such things. Don't forget that, in general, the customer will have more confidence in your product if you can convince him that you know how it works. He is thus flattered by being served by an expert and trusts your judgement.

Heat, whether in air, water, food, glowing coals, or anything else, will always flow from a warmer to a colder body. Cold, after all, is only lack of heat in the same way that darkness is lack of light. In an ice box, the ice has less heat than the surrounding food, and heat flows from the food to the ice where it is absorbed in converting the ice to water. Thus losing heat, the food becomes colder. The insulation of the ice box prevents the outside heat of the air from travelling into the ice box and wasting the ice. In one type of refrigerator, a chemical solution is used to absorb and carry off the heat. By chemical means, the solution has the heat extracted from it, and this solution is used in cycles over and over again. This is the type of refrigerator operating from a gas flame, kerosene

lamp or electric heater. Its action is rather more complicated than that of the compressor type.

Compressor Type Refrigerators:

When a liquid boils, heat continues to be absorbed by the liquid, but the temperature of the liquid does not increase. In the case of water, the boiling point is 100°C. or 212°F., and the application of more or less heat to the boiling water does not affect the temperature. The application of more heat only increases the amount of steam given off. Thus, when a liquid boils, it can absorb a considerable amount of heat. Such absorbed heat is termed the latent heat of evaporation. When steam or other vapour condenses to liquid again, it gives up this extra heat.

Compressor types of refrigerators depend on the phenomena of latent heat for their operation. Remember, heat flows from the hotter to the colder body. When a vapour or gas is compressed, it becomes heated. Notice how a bicycle pump or other air compressor becomes hot when operating. Let us take a liquid which has a low boiling point. If it is a commercial refrigerant with a boiling point of, say 21°F. below zero, then while turning from a liquid to a gas it will absorb large quantities of heat from any substance above this temperature. Now, if compressed in the gaseous form, it will heat up due to the pressure. When the compressed gas is above the temperature of the air, heat will flow from it to the air, so that, when the pressure is released, the gas will drop considerably in temperature. In most cases, the drop will be sufficiently low to turn it back into a liquid, whereupon it is allowed to boil again and once more extract heat from food inside the refrigerator cabinet. The compressor (in almost every case driven by an electric motor), is the piece of equipment which compresses the gas. The condenser (the rows of finned tubes in the compressor compartment), is the place where the compressed air gives off the heat to the air. The evaporator(sometimes termed the "freezer compartment" inside the cabinet), is the place where the liquid boils and absorbs heat from within the cabinet. The cycle of compression, condensing and evaporation is continuous as long as the refrigerator runs. The electric supply to the compressor motor is controlled by a temperature sensitive switch (the thermostat) within the cabinet. When the cabinet becomes too warm, it switches on the motor operating the refrigeration cycle, and likewise switches it off when the temperature drops. The dial control for the temperature level merely changes the setting of the thermostat. So much for an extremely sketchy outline of the operating principles of refrigerators.

The advantages of a refrigerator:

Some of the advantages gained from ownership of a refrigerator have been listed earlier in this article, but with certain customers, however, we can be more specific concerning the part low temperature plays in the storage of foodstuffs. Don't forget to emphasise the refrigerator's great gift to the housewife in the form of the home production of frozen delicacies, frozen cakes of various types, ice cream and iced drinks. A good salesman must be knowledgeable on this point, even to the extent of possessing proved sample recipes covering a wide range of frozen dainties.

The more scientifically minded customer will be interested in the prevention of the growth of micro-organism (bacteria, funguses, etc.) at low temperature. In the interests of safety, meat, milk products and other foodstuffs are subject to rigid inspection during their production. Such advantages, for which the customer has paid, are lost should the food be wrongly stored within the home. Never forget that New Zealand's primary export trade is dependent upon low temperature storage of meat and milk products during shipment to overseas markets.

Undoubtedly, the housewife, and the farmwife in particular, employs many methods of preserving food, but, where minimum changes are required during the storage, refrigeration has no competitor. With low temperature storage, there is less all round loss of vitamin content than with any other method within reasonable grasp of home operation.

The Customer:

So far, we have spoken of the refrigerator with respect to the customer; now let us consider the customer with respect to the refrigerator. Before he is prepared to buy a particular refrigerator, a customer seeks satisfaction on four points, viz.:

(a) Has he a definite need for a refrigerator.

(b) Is a BLANK refrigerator the best type for his purposes.

(c) What assurance has he that (b) is correct?

(d) Is this refrigerator worth the money?

Now, let us consider these in turn, for, unless each question is answered affirmatively, no sale can result. No doubt, before you meet the prospective customer, he will have given some consideration to these questions, so, in fairness to both him and yourself, you must be prepared to see his point of view and frankly discuss his various problems. No set sales story will suit every customer equally.

Who needs a refrigerator?

It can be said fairly and safely that every family in New Zealand will derive benefit from owning and operating a refrigerator. The customer's four chief motives in considering such a purchase are:—

(a) Profit and economy.

(b) Convenience and comfort.

(c) Safety and health.

(d) Prestige and pride of ownership.

With each customer one of these motives will predominate. It is the salesman's job to discover and press this particular angle, while not losing sight of the other three points. A proud father and a happy young mother will be specially interested in "health and safety," while grandfather will want to provide grandmother with "comfort and convenience." Each customer and his particular needs must be studied individually. Here, perhaps the country trader has considerable advantage over his city colleague.

Proving your product:

This is where real salesmanship comes to the fore. You must know your product, all its advantages and its disadvantages. You should be able to quote the names of satisfied users. You must know

somthing about competitive products and be able to discuss them fairly, under no circumstances outraging your customer's sense of sportsmanship by disparaging a competitor in his absence.

Facts you must have at your finger tips include the names of persons of local importance who have installed your products, mutual acquaintances who will speak well of you and your products, the numbers of each brand of refrigerator sold, and mechanical advantages, improvements and conveniences of the various types and makes. The latter can be obtained from trade literature. It is vital to study advertisements with care, and read as much about this subject as possible in trade journals, etc. In this respect, we hope that this review will fill a long felt want among radio and electrical dealers in New Zealand. You can keep abreast of the latest information only if it is conveniently given to you. That will be one of the functions of "Radio and Electrical Review."

Customer assurance:

You must offer proof of the reliability of the manufacturer of the refrigerator you are selling, and that his regard for his reputation is too great to allow of his producing a shoddy article. Your own reputation must be above reproach. Customers must be assured that both you and the manufacturer stand fully behind the product, and that you, personally, are convinced that your reputation will never suffer from handling that particular product. You must point out the protection offered by the guarantee, and be prepared and willing to service the equipment after the sale is completed.

Price:

Price is not as big a criterion is is often believed. An intelligent customer can always be convinced that there is greater value in a good, sound commodity produced and sold by people of repute, than there is in any bargain of doubtful merit. Sell service and satisfaction, and any price difference ceases to count.

Servicing:

Apparently, refrigerator manufacturers in New Zealand have difficulty in persuading dealers to undertake servicing. Inability or reluctance to service apparatus sold, however, is very short sighted policy.

Essentially a refrigerator is a simple piece of apparatus, but several of its components are sufficiently complex to prevent any manufacturer providing economically against simple faults. This point is recognized by reputable manufacturers, who include in the dealer's commission a sum covering the cost of servicing during the guarantee period. Surely, therefore, if manufacturers recognize the need for servicing, it is equally important that dealers should be prepared to undertake this.

Undoubtedly, the main disadvantage of servicing under guarantee is that the dealer has received the reward for such work already, in which case servicing appears to be a dead loss, or else the monetary return is much less than normally obtained from other classes of work. Apart altogether from the morality of such a view, however, there are other points he would do well to consider.

Every dealer will recognize that no sale can take place without first some contact between the seller and the prospective customer. Normally, this is done by advertising, and, quite rightly, the dealer will expend large sums of money advertising not only the quality of his products, but also the integrity of his business. Through the quality of his products and the service provided, he will spare no effort to establish his reputation as a sound, honest and helpful businessman.

One sure way of achieving this is by undertaking, with the help of the manufacturer, the servicing of refrigerators both within the guarantee period and after the expiry of the latter. Very quickly such a dealer will acquire the reputation of a local expert, and potential customers will flock to consult him concerning the merits of various brands for, with such service and repair experience, his expert opinion is worth having. Thus, he will be in on the "ground floor" with both old and new customers. If you are that dealer, when a larger and more modern refrigerator is wanted, that new sale can be yours.

Therefore, far from being reluctant to accept the responsibility for service under guarantee, the dealer should hasten to take advantage of the extra contacts and goodwill accrued from helpful, speedy and cheerful acceptance of his obligations. Skill and experience will soon reduce the time expended in servicing. Preferably, the dealer should acquire this experience himself, or, failing that, should employ a skilled and experienced serviceman. Admittedly, there is a shortage of trained refrigeration servicemen, and alas, a dearth of instruction offering. However, dealers can remedy this state of affairs. Acceptance of servicing obligations will have the full support of your manufacturer. The latter is only too willing to place his not inconsiderable training facilities at your disposal.

Explain to him or his representative the difficulty in obtaining the necessary instruction or securing and training a skilled serviceman. Refrigeration servicing and engineering offers an attractive and lucrative career for young tradesmen. If you know someone interested in assisting you in this direction and helping solve your servicing problems, advise your manufacturer. Should sufficient numbers require tuition, rest assured that it will be arranged.

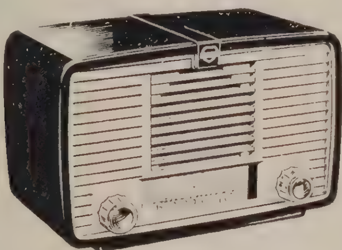
Summarising therefore, household refrigerators represent BIG BUSINESS, and you cannot afford to ignore this expanding field. Sell refrigerators honestly and knowledgeably, accept your service obligations cheerfully and speedily, and watch your profits climb!

NEW PRODUCTS: LATEST RELEASES IN ELECTRICAL AND ELECTRONIC EQUIPMENT

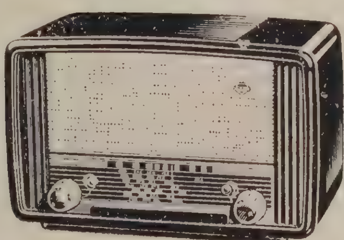
This section of our paper is reserved for the introduction of new products and space preference is given to our regular advertisers. Advertising rates are charged according to space occupied. For further particulars contact Advertising Manager, R. and E., Box 8022, Wellington.

MULLARD RADIO

Messrs. C. and A. Odlin Co. Ltd., New Zealand Distributors of Mullard products, are pleased to announce the release of six new Mullard Radio Receivers.



Model 454. The new "Baby Grand" Model 454 is a four-valve Superhet Broadcast Receiver, housed in a two-tone moulded cabinet of striking appearance with illuminated dial. (Specially built-in FERROCEPTOR (Ferroxcube) rod aerial giving maximum performance without the necessity for outside aerial. The Mullard Valves used are the types UCH42, UAF42, UL41 and UY41. Five-inch Ticonal Speaker. Cabinet dimensions 10½ in. wide 6½ in. high. RETAIL £14 17 6d.



Model 522 is a medium sized set housed in a moulded cabinet 12½ in. wide 7⅝ in. high. Chassis is a 5 valve broadcast using the following Mullard valves, UCH42, UAF42, UBC41, UL41 and UY41. This Model, too, is equipped with the amazing FERROCEPTOR built-in rod aerial. RETAIL £17 17s. 6d.

MULLARD RADIOGRAMS

The demand for "high fidelity" is a growing demand and the listener to whom music is important is not satisfied with merely "pleasant music." While Mullard's eleven valve all-wave De Luxe Console Radiogram Model 1100 covers in every detail the requirements of these listeners, there are many who are either not in a position to purchase such a machine or prefer a table model. To cater for these people, Mullard have released the undermentioned moderately priced radiograms in which craftsmanship, design and quality are of the same high standard that has always been a characteristic of Mullard Receivers. They have excellent sensitivity and output with "true to life" tone on both Radio and Gram.

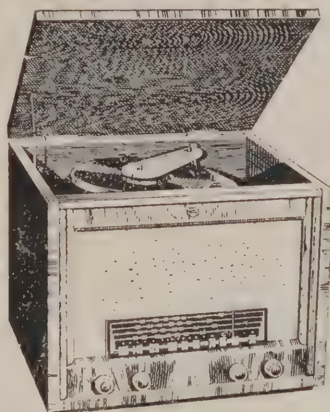
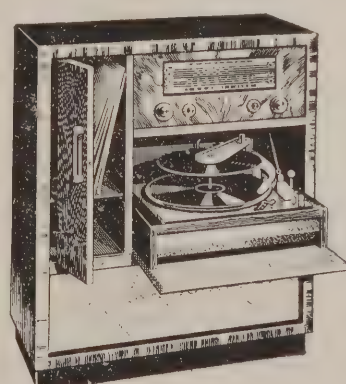


Table Model 545 (illustrated) is equipped with three speed automatic Record Changer, housed in a modernistic walnut cabinet—specially reinforced to avoid microphonics between speaker and chassis—new features include the use of two new valves namely ECH81—Triode hexode, frequency converter and EBF80— double diode pentode—I.F. amplifier, signal detector and delayed A.V.C. Also incorporated is the FERROCEPTOR (Ferroxcube) built-in rod aerial. RETAIL PRICE £59 15s. 0d.

Model 534 (similar to the Model 545) but in cabinet of slightly smaller dimensions and equipped with three speed record player. RETAIL PRICE £46.



Model 599. (Illustrated). Thoughtfully designed to give superb performance with attractive appearance, this new Mullard Console Radiogram is distinguished by its sound technical efficiency and fine quality of reproduction. Equipped with three speed Automatic Record Changer. RETAIL £83 15s. 0d.

(Continued on page 44)

Model 588. Similar to model 599 but with three speed player. RETAIL £72 10s. 0d.

* * *

B.S.R. NEW "MONARCH" MODEL

Tops in popularity and sales, the B.S.R. new model "Monarch" auto-changer is being produced in England at the rate of 5,000 units weekly for world wide distribution. The Manufacturers, Birmingham Sound Reproducers Ltd., have also established production of the new "Monarch" at their Canadian factory, where English production techniques are followed.

The new "Monarch" is of the same robust construction as the previous unit, with enhanced de luxe, streamlined finish. The reliable design and quick changing characteristics have been improved.

The "Magidisk" feature, exclusive to the "Monarch," permits the use of mixed 7 in., 10 in. and 12 in. records.

New features include a handsome white moulded pick-up arm, and a white perspex moulded control arm, which will prevent damage to records. The simplified control knob has been centralised, permitting easy access in any type of cabinet.

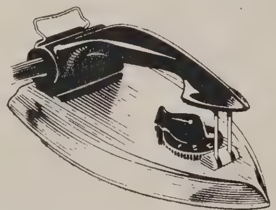
The new "Monarch" has been rust proofed by the "MET-L-ETCH" process, ensuring long life to the mechanism and metal parts.

B.S.R. products are being distributed in New Zealand by E.M.I. Suppliers (trade division of H.M.V. (N.Z.) Ltd.), P.O. Box 296, Wellington.

* * *

THE MORPHY-RICHARDS AUTO TRAVEL IRON

Another new appliance to be added to the ever increasing famous range of Morphy-Richards appliances is the Auto Travel Iron.



This new appliance which operates on all A.C. and D.C. voltages from 100 to 250 volts by an ingenious automatic voltage selection control should prove a boon to travellers, holiday makers and the business girl in flattettes etc.

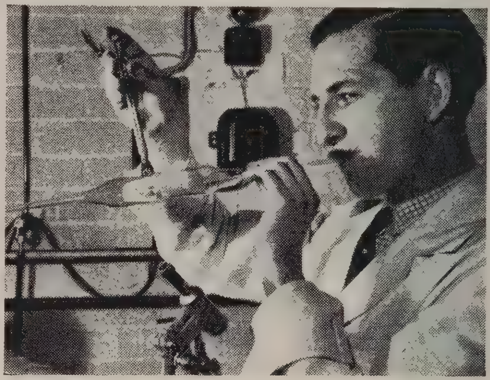
Not only does this iron eliminate all worry as to the voltage used on ships etc., as it automatically operates on all voltages, but the handle folds down to permit ease of packing.

The new Morphy-Richards Auto Travel Iron which is a worthy partner of the standard Morphy-Richards Auto Iron and other famous Morphy-Richards products is distributed in New Zealand by the Russell Import Co. Ltd., P.O. Box 102, Wellington, to whom all Morphy-Richards enquiries should be addressed.

BACK NUMBERS OF "R. & E."
Available from our Office,
P.O. Box 8022, Wellington.

Tailor-made Switches for World's Power Stations

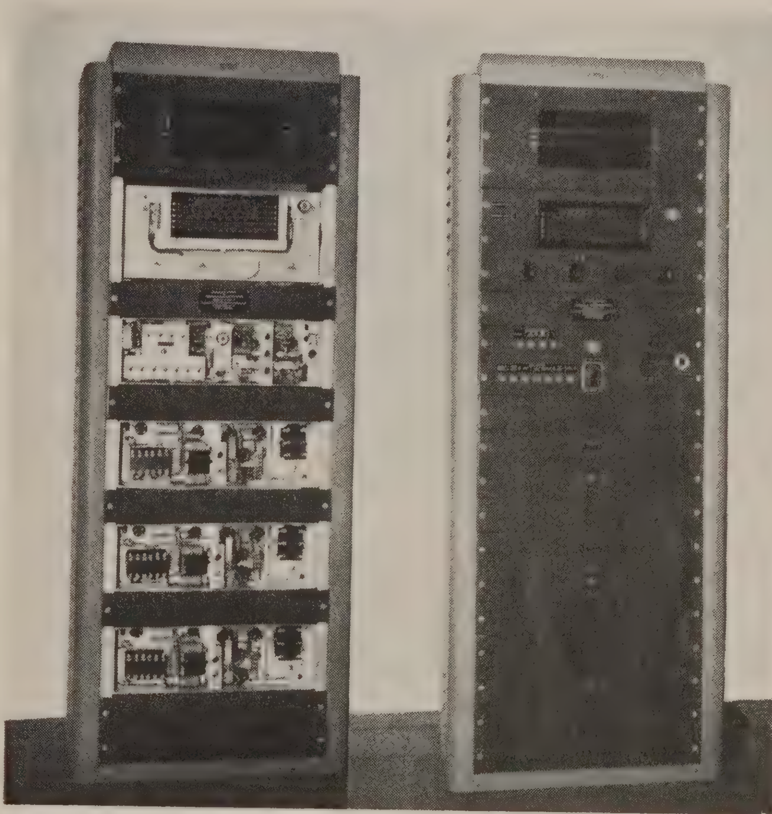
Mercury Switch controls with a wide variety of applications are being produced at a Boreham Wood, Hertfordshire factory, at the rate of 5,000 a week. Each of these switches has to be "tailor-made" to suit specific needs, and the capacity range is from one to 250 amps. This expert glassblower at the factory is seen fashioning one of the 250 amp. types—the largest ever made. A great many of the switches made at the Boreham



Wood have been specially designed for use in power stations being built in Britain as well as new power stations being built in South East Asia under the Colombo Plan. Standardisation does not exist to anything like the same degree as in American practice. Coupled with war time demands this has made the British industry resilient and led to the development techniques which are rapidly giving Britain a world lead in the manufacture of this type of equipment.

RADIO (1936) LTD. AND THE "MAORI"

A good example of the versatility of New Zealand's radio manufacturers is the way in which they can tackle complex special equipment, and make a thoroughly good job of it as easily as they can produce a natty line in portable radios, or high-quality radio gramophones. Radio (1936) Ltd., for example, has designed and built the sound equipment for a number of New Zealand ships, including the Matua and the new Tofua, but the latest to go into service is that aboard the Union Steamship Company's new Maori, which has now settled into her routine on the Wellington-Lyttelton run.



The equipment referred to is designed to feed a total of 38 speakers in different parts of the ship, connected in eleven groups, any of which may be selected by switching arrangements. The specification called for audio power output of 80 watts, thus allowing just over 2 watts per speaker. It is interesting to note that the designers have obtained the necessary power output by using three medium-powered amplifiers rather than one high-powered one. This obviously limits the effect of an amplifier fault to a third of the speakers, as well as making the system easier to design and possibly less bulky.

The main purpose of the equipment is to allow announcements to be made to the whole, or any part of the ship, from either of two microphones. One of these is situated at the equipment itself, and the other on the bridge. The latter position is also provided with remote control of the amplifier and the speaker selection. Arrangements have been made whereby the microphone position on the bridge is in complete and over-riding control. For instance, if music is being supplied to one part of the ship from the radio receiver which is built into the rack, the bridge automatically silences the receiver if its microphone is opened in order to make an announcement. Operation is by "press-to-talk," with pre-set microphone gain controls, so that all that is necessary should the officer of the watch or the captain have to make an emergency announcement is for him to turn on the equipment and talk. It is automatically arranged that when the amplifiers are used for announcements, all amplifiers and speakers are in use. When in use for radio programmes, only those speakers required are manually selected by means of the built-in control panel.

The accompanying photographs depict the main unit. One illustration shows the direct access possible to the power amplifier unit for routine tests and maintenance, while the panels still in position are removable for access to the back of the unit so that valve changes can be made when required.

The equipment, complete with operating spares, was originally supplied while the ship was fitting out in England, and was installed there. It is very pleasing to see co-operation of this sort between a New Zealand ship-owner and a New Zealand radio manufacturer, for not only is it a very practical arrangement to have special equipment, which is to be used on this side of the world, designed and built here, but it shows that after a sufficiently long time, it is being realised that the New Zealand radio industry has more to offer the purchasers of radio equipment than merely domestic radio receivers. Our congratulations go to Radio Ltd. for having secured and carried out this project.

FOR THE TECHNICIAN

The Collaro Model R.C.500 Automatic Record Changer

FIG. 1.

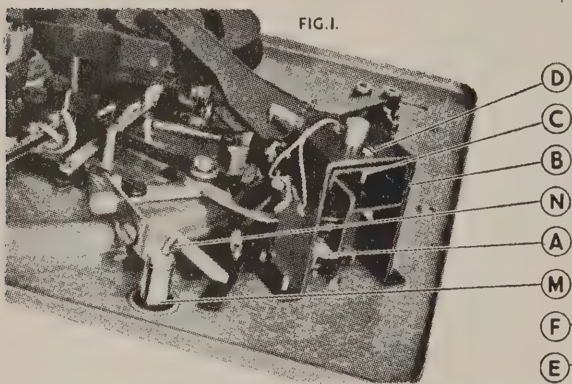


FIG. 2.

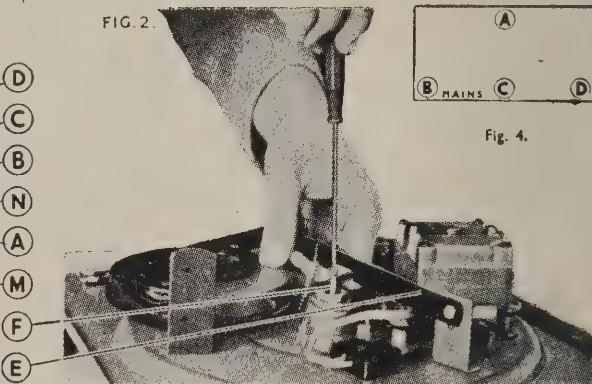


Fig. 4.

PICK UP POSITIONING

The machine is adjusted at the Factory to set down the Stylus at a radius of 4 13/16 in. for 10 in. Records and 5¾ in. for 12 in. Records, these positions having been determined as the most suitable from examination of a very large number of records of various types. It will be found suitable for all modern recordings and all but a few old recordings.

The adjustment provided affects both 10 in. and 12 in. positions equally.

1. In the case of machines manufactured since June, 1950, adjustment is made by means of the two set screws which secure the bracket carrying the Pickup Arm to the vertical spindle housed in the Pickup base. These two screws will be found facing forward immediately beneath the Pickup Arm and above the Unit plate. To move dropping position outwards, loosen outer screw and tighten inner screw about ⅛th of a turn at a time until desired position is obtained. To move dropping position inwards, loosen inner screw and tighten outer screw in the same way. Be sure both screws are finally well tightened.

2. In the case of machines manufactured prior to June, 1950, the bracket carrying the Pickup Arm is attached to the vertical spindle housed in the Pick-up Base by means of a single grubscrew facing backward, and adjustment is effected as follows. Switch machine on to the 10 in. position and start up in the normal manner to determine amount of error in positioning. Leave the machine in playing position (i.e. with cycle complete) and switch off at mains. Undo clamp nut fitted to pickup operating lever A (fig 1). Insert screwdriver blade between operating lever clamp nut and pickup operating bracket B (fig. 1) to act as stop, and move pickup by hand to correct position. Remove screwdriver and tighten clamp nut. If pickup has to be moved in an outward direction the screwdriver should be in between parts A and B on the side nearer the motor and vice-versa.

PICKUP HEIGHT ADJUSTMENT

If the height of the pickup has ever to be adjusted, the nut C (fig. 1), should be slackened and screw D (fig. 1), adjusted as required. Turning screw D in a clockwise direction raises the pickup—and turning it in an anti-clockwise direction lowers the pick-up. Nut C should then be tightened.

MOTOR

No maintenance of the motor is necessary, but in the event of the supply frequency being changed the motor pulley must be changed accordingly. To do this, undo the three nuts holding the motor to the unit plate, and remove motor. The appropriate pulley whether for 40, 50 or 60 cycle supply should then be fitted and the motor replaced. The three nuts should then be replaced and tightened to their stops.

Each changer is normally packed wired for 200/250 volt AC supply. For 100/130 volt AC supply, the two leads should be disconnected from Terminal A in Figure 4, and one each connected to Terminals B and D. The mains connections should always be made to Terminals B and C.

RECORD DROPPING

If more than one record drops at a time, examine the centre holes of your records. If these are badly worn, their use should be avoided. If the record holes are not worn, see that the record retaining slide in the top position on the record spindle is perfectly free. If there is any suspicion of the spring or slide binding, this must be freed by removing the screw at the top of the spindle and carefully cleaning in petrol the slide and spring which should then be replaced.

If records fail to drop, care should be taken to see that the record selector pawl in the bottom half of the record spindle rises into the hole in the record, and moves forward far enough to push the record off the shelf. This is best done with one record on

the spindle and starting up the changer in the normal way. If the selector pawl is not moving sufficiently, the remedy is as follows: Lift record dropping lever E, (fig. 2) out of slot of record dropping pad F (fig. 2) taking care not to stretch the spring unduly. Insert screwdriver in slot and turn one half to one turn in anti-clockwise direction. This will increase travel of record selector pawl. (This must not be over-done as jamming of the mechanism will result). Likewise movement of the pad in a clockwise direction will reduce the movement of the selector pawl. The record dropping lever should then be inserted in the slot of the Record dropping pad.

SWITCHING OFF

In the event of the machine failing to switch-off after the last record has been played, it may be due to one of the following reasons:—

1. The balancing arm spindle M (fig. 1), is not falling to its full extent and making contact with the pin N (fig. 1). This will be due to the balancing arm spindle sticking in its housing, and this should be freed.

2. The anti-jamming cam G, (fig. 1), may have slipped and should be re-set in correct relationship to the main cam H, (fig. 3). The method of adjustment is as follows:—The screw L on the cam G, should be unscrewed. With roller J (fig. 3), at peak of cam track as shown at (fig. 3), the face of slide K should be set in contact with the face of the cam G as shown in the diagram. Screw L should then be re-tightened.

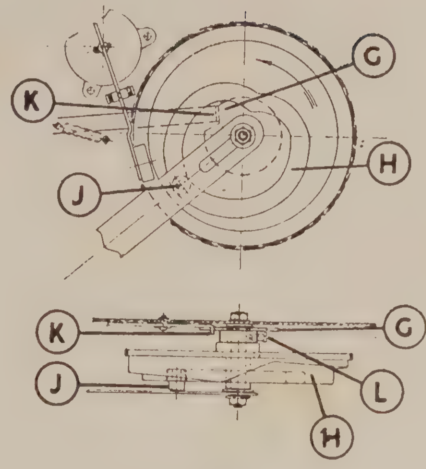


Fig. 3.

TRADE WINDS

EMIDICTA

Messrs. H.M.V. (N.Z.) Ltd are pleased to announce that Messrs. Armstrong and Springhall Ltd. have been appointed distributors of the "Emidicta" dictation machine.

Distribution will be undertaken by their various branches and agents throughout New Zealand and at Suva, Fiji.

Over 700 Emidicta machines have been sold in New Zealand already, and all users are assured of expert service from Messrs. Armstrong and Springhall Ltd. and their agents.

* * *

W. S. GREEN & CO., LTD.

W. S. Green and Company Limited is to open a new city office at 157 Lambton Quay, Wellington, shortly. Dealers will be interested to learn that this progressive firm has acquired a number of new Agencies for interesting lines of radio equipment. Inquiries should be directed to P.O. Box 2303, Wellington.

Ted Reid and Wally Green photographed in Dunedin

* * *

RADIO LICENCES TOTAL 506,323

Showing an increase of 9,968 over the figures at the the end of March, 1953, radio licences, as at the end of March, 1954, totalled 506,323, including 499,130 broadcast receiving licences.

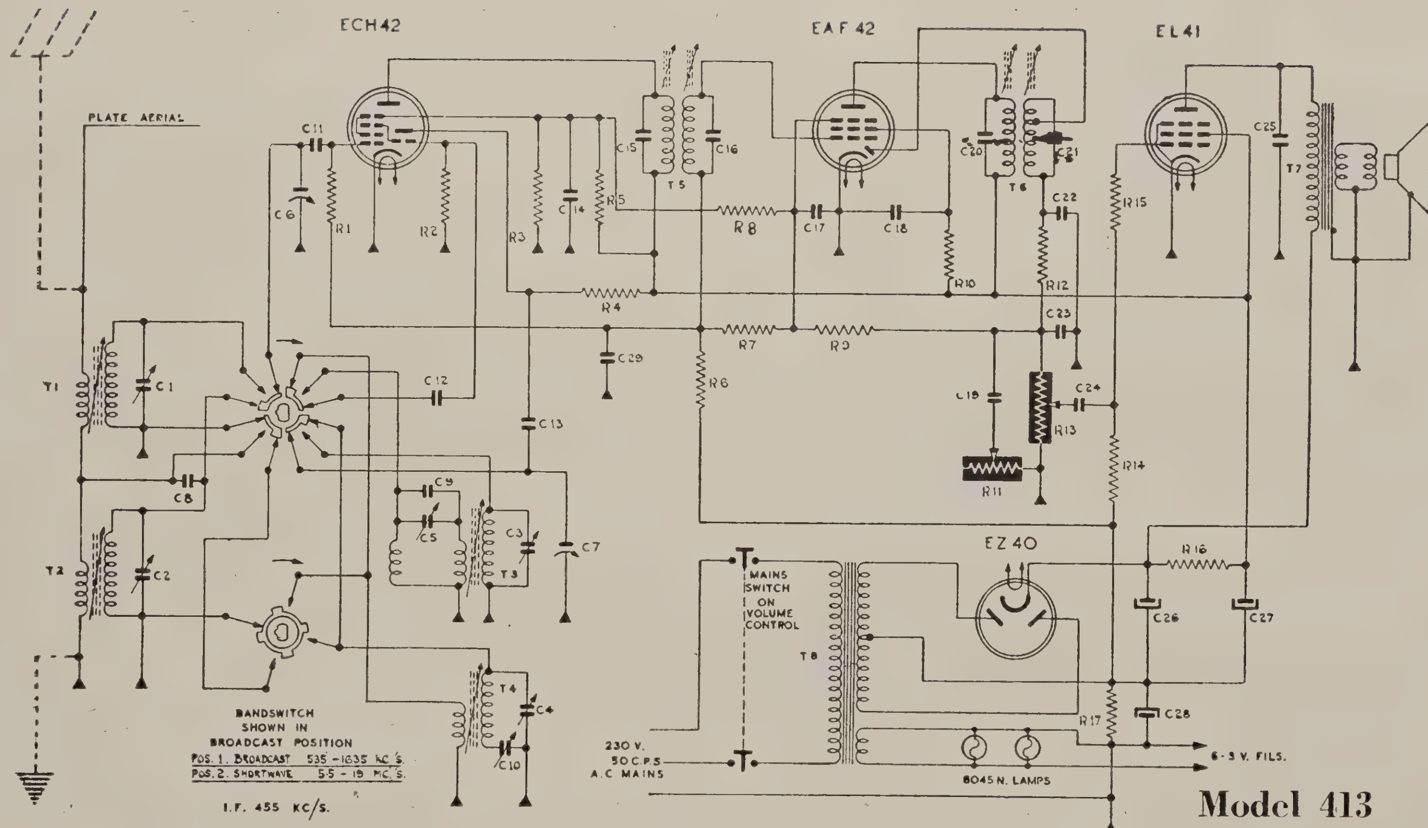
Increases in the number of amateur and research stations are particularly noteworthy, the totals at the end of March, 1954, being 2,336 and 73 respectively, whereas last year they were 2,264 and 70.

District figures are:—Auckland, 104,414; Blenheim, 5,004; Christchurch, 65,139; Dunedin, 38,076; Gisborne, 8,259; Greymouth, 6,654; Hamilton, 49,405; Invercargill, 21,050; Masterton, 12,728; Napier, 20,823; Nelson, 10,629; New Plymouth, 19,743; Oamaru, 5,191; Palmerston North, 19,377; Thames, 8,496; Timaru, 12,669; Wanganui, 16,239; Wellington, 59,074; Westport, 2,575; Whangarei 16,205.

FRED ROTHSCHILD

We are always glad to welcome new advertisers to our pages, and although Fred Rothschild has been with us for several months now, this firm is one of the latest to enter the radio and electrical wholesale trade. This part of Mr. Rothschild's business is being ably handled by Mr. Peter Rothschild, who is a keen supporter of the Wellington branch of the New Zealand Electronics Institute (Inc.), and who takes a lively interest in all matters electronic. This interest is reflected in some of the agencies held by this progressive firm. Among the overseas concerns it represents are Technograph Ltd., who specialize in the manufacture of strain gauges and printed circuits, John Bell and Croyden Ltd., makers of sub-miniature transformers and chokes, Magnetic Coatings Ltd., makers of recording tapes, Acru Electric Ltd., soldering irons, precision tools etc., and many others, with whose products readers will no doubt be familiar.

THE MULLARD MODEL 413



Model 413

C1	3-30 mmfd air trimmer	C13	500 mmfd mica	C25	0.005 mfd 750v.	R7	750k ¼w. carbon		
C2	,, ,, ,, ,,	C14	0.01 mfd 500v.	C26	50 mfd 350v. } Triple	R8	15 meg. ½ w. carbon		
C3	,, ,, ,, ,,	C15	110 mmfd I.F. condenser	C27	50 mfd 350v. } electro-	R9	1 meg. ¼w. ,,	T1	S.W. aerial coil VK 469-55
C4	,, ,, ,, ,,	C16	,, ,, ,, ,,	C28	100 mfd 10v. } lytic	R10	100k ¼w. carbon	T2	B.C. ,, ,, VK 469-54
C5	,, ,, ,, ,,	C17	400 mmfd mica	C29	0.05 mfd 350v.	R11	500k tone control	T3	S.W. oscillator coil VK 471-37
C6	12-500 mmfd tuning condenser	C18	0.01 mfd 500v.			R12	68k ¼w. carbon	T4	B.C. ,, ,, VK 471-36
C7	,, ,, ,, ,,	C19	0.002 mfd 500v.	R1	1 meg. ¼w. carbon	R13	500k volume control	T5	1st I.F. filter A3 121-94
C8	3.9 mmfd ceramic	C20	110 mmfd I.F. condenser	R2	47k ¼w. carbon	R14	750k ¼w. carbon	T6	2nd ,, ,, A3 121-94
C9	100 ,, ,,	C21	,, ,, ,, ,,	R3	47k ¼w. ,,	R15	25k ¼w ,,	T7	Output transformer VK 670-71
C10	600 mmfd padder	C22	100 mmfd ceramic	R4	25k ¼w. ,,	R16	1500 ohms 1w. carbon	T8	Power ,, VK 630-62
C11	150 mmfd ceramic	C23	,, ,, ,,	R5	25k 1w. ,,	R17	100 ohms 1w. ,,		
C12	56 ,, ,,	C24	0.01 mfd 500v.	R6	2 meg. ¼w. carbon				

RADIO AND ELECTRICAL MARKETING

Editor's Note

"Radio and Electrical Review" has been very fortunate in securing the services of Mr. W. L. Young, who is well known to many of our readers as General Manager of the Russell Import Co. Ltd., to write a series of articles on the selling of radio and electrical equipment. In the short article below, Mr. Young introduces the series, which will commence in an early issue.

There are several different approaches to electronic or electrical equipment. Readers will probably be able to carry their minds back to their first introduction, say, to radio. This usually took the form of an interest developed perhaps in the nature of a hobby. People in various walks of life get considerable pleasure from radio and for that matter, electrical gadgets, from the angle of a hobby and relaxation. Frequently, however, this initial approach changes, and, instead of being a hobby, the amount of time given and interest taken, increases to the point where a livelihood is secured from radio and the various electric and electronic devices which have become associated with what was once their hobby.

Even when a livelihood is secured from radio, or for that matter, in the broader radio and electronic field, this livelihood can be won either by following the subject from the purely technical angle, or by following the industry on the commercial side or sales side as it is often called. Whilst both fields are highly specialised, technical people, in general, are not perhaps as willing to consider the special nature of selling in the radio and electrical industry, as the sales personnel are to gladly concede that the technical side is of a specialist nature. However, it must be conceded that there has to be "knowhow" on the sales as well as the technical side.

While there are specialists in both fields, in general terms, it is found that a "technical" man has some ideas on sales problems, and a "sales" man has some idea of technical problems. No one will question that the many articles which have appeared over a period of years in this journal have covered comprehensively, the numerous technical problems which have to be dealt with.

With the broadening of the scope of "Radio and Electrical Review," it is thought that some special attention given to sales methods would be of interest to readers. Throughout New Zealand, there are many radio and electrical businesses giving an excellent service to their customers, and if the articles which follow in later issues will be of use in developing further sales of such businesses, then a useful purpose is served. No business can run without profit and the dealer who is giving a good technical service is more entitled than anyone else to the profits which can be secured from the sale of new merchandise. The extra profit will allow even further development of the service angle and no one can disagree with the fact that without service the radio or electrical industry would collapse.

If our technical readers will give a little time to the next two or three articles which will be written on the subject of selling, it is confidently expected that all will profit a little and some may profit a great deal.

Missing and Stolen Radios

HAMILTON

Autocrat 8 valve, 12 volt car radio, serial No. 12743. Brown metal cabinet 7 in. x 2½ in. x 6 in., two white knobs, cream and gold dial.

PATEA

Sonomatic 6 volt auto radio. Grey metal case 9 in. x 8 in. x 4 in., two knobs.

WANGANUI

Pacific type 6 A.H. 6 valve, 6 volt auto radio, serial No. 2010. Speaker unit 9 in. diameter x 5 in. deep with metal mesh grille. Tuning unit 10-12 in. x 6 in. sq. with diagonal dial panel. Aerial lead on right. Red control knobs. Units connected by 5 pin lead.

NAPIER

Motorola model 405, 6 volt auto radio, serial No. 4/2572. Complete in one unit. Cabinet pale blue with white volume and tuning knobs.

WELLINGTON

Marconi portable, serial No. P.20B. Cream bakelite case 9 in. x 5 in. x 4 in. with imitation lizard skin round sides and end. Letter "A" scratched on top of lid.

Phillips 5 valve A.C./D.C. portable radio, model No. 536, serial No. 63663/89174. Maroon plastic case 12 in. x 9 in. x 6 in., with open front and handle moulded into top of case.

LOWER HUTT

Pye model PZ65 battery/electric 7 valve portable radio, serial No. 42330. Blue and grey steel plastic case, carrying handle on top, dial on top of radio and two tuning knobs.

Pacemaker model 519, 5 valve, battery/electric portable, serial No. 84049. Brown leatherette case with handle on top. Screws holding back in place do not match and leatherette under tuning knob worn to an orange colour with use.

R.C.A. Victor battery portable. Green plastic case, round dial with numbers 55 to 160, weighs under 5lb., small sliding switch on top left corner.

Tuner unit of Autocrat 12 volt broadcast car radio, serial No. 12808. Brown case 7 in. x 6 in. x 2½ in. with chromium front and 2 white fluted knobs.

CHRISTCHURCH

Paramount 3 or 4 valve mantel radio in golden brown wooden cabinet with dial marked in old wave lengths.

INVERCARGILL

Bell 5 valve, battery/electric portable radio. Oval black plastic cabinet 12in. x 6 in. x 7 in. with three controls and white plastic handle. Dial indicator moves horizontally.

RADIO RECOVERED

H.M.V. Auto Radio, serial No. 15159.

Annual Conference Of N.Z. Radio And Electrical Traders' Federation

Held in Wellington on the 25th and 26th May last, the Annual Conference of the N.Z. Radio and Electrical Traders' Federation was well attended by delegates and observers from the various affiliated branches throughout New Zealand, and two representatives, Mr. C. R. Peoples and Mr. J. Beachen, from the Auckland Radio, Television and Electrical Traders' Association, to whom a special welcome was extended.

A summary of the President's annual report was printed on page 42 of the June, 1954, issue of "Radio and Electrical Review."

Matters considered by the Conference included:

Dry Batteries:
After several members had reported on the difficulty of procuring supplies of hearing aid batteries, Mr. O'Sullivan of the National Carbon Pty. Ltd., announced that the shortage of this particular type of battery both in England and New Zealand had now been overcome, and he hoped that there would be no further cause for complaint.

Trade-In Hand-book:
Discussion revealed that this was serving a useful purpose. In future, it was suggested that sets of a trade-in value below £3 should not have the original value shown, as the latter made it difficult to persuade a customer that his set was worth so little.

Register of Bonafide Radio Dealers:
This list has now been completed, and will be circulated shortly to affiliated associations.

Concern was expressed at the ease with which radio dealers' licences could be obtained by persons using the business of radio repairs merely as a lucrative hobby. Auckland representatives told of methods adopted to combat this in their district by maintaining a rigid check on the circulated list. Difficulty is experienced with co-operative buying associations, such as the Public Service Association, whose discounts the Auckland Association is endeavouring to eliminate. On the other hand, it seems advisable to grant discounts to industrial concerns which are large buyers of radio and electronic parts, even though such concerns do not themselves deal in radios or radio parts.

Radio Dealers' Licences:
The Taranaki remit, "That Radio Dealers' Licenses be reviewed as licences come due, to discontinue the indiscriminate granting of such licence to all who apply, and limit the granting of same only to those persons or firms actively engaged in the sale and/or repair of radios," failed. Members felt that the difficulty mentioned would be overcome largely by the issue of the Federation list of accredited radio dealers, and that it would be imprudent to permit the Post and Telegraph Department to decide who was entitled to licences.

Radio Interference:
The Conference viewed with extreme concern the increasing incidence of radio interference, which is greatly impairing the reception of radio programmes, and decided that the Federation should approach the appropriate Minister with an urgent request for the prohibition of the importation, manufacture and sale of any electrical equipment capable of causing radio interference. The Conference further recommended that legislation be enacted to give radio inspectors power to eliminate present causes of interference. It was decided to inform the Manufacturers' and Retailers' Federations of this action, at the same time pointing out the serious effect of such interference on the reception of the latters' advertisements from commercial stations. In their own interests, therefore, the Manufacturers and Retailers should support the Federation's efforts to have the nuisance eliminated.

Guarantee Period:
During consideration of the Wanganui remit "that the Federation recommend to all manufacturers the adoption of the International guarantee of ninety days for radios," it was pointed out that dealers' difficulties related to labour and time expenses rather than the value of materials used. However, as long as one local manufacturer, retailing his own sets, continues to give twelve months' guarantee, others feel that they must do likewise. In the opinion of some delegates, this is not as serious a problem as it seems, and no difficulty has been experienced in selling sets against competition from retailers providing the twelve months' guarantee. Nevertheless, the remit was passed, and the Executive instructed to take up the matter with the Manufacturers' Federation.

Car Radios:
After brief discussion, the Taranaki Association withdrew its remit "that urgent consideration be given to the channelling of car radios from the manufacturer to the radio trade instead of to the motor trade." In some cases, the radio is fitted by the manufacturers of the cars, and in others, supplied by the distributor, though not fitted. No doubt it would be difficult to induce radio manufacturers to give up such a lucrative business with car dealers. However, it was recommended that the radio traders should endeavour to make arrangements with garages to install all car radios sold by the garages.

Registered Radio Servicemen:
Concern was expressed over the recent legislation compelling radio servicemen to qualify by examination, and it was suggested that, where unqualified servicemen had many years' experience in the radio industry, they should be granted a Certificate of Registration based on this, without having to qualify by examination. However, it was pointed out that the new legislation brought a number of advantages, and that it was possible to qualify while working in a radio manufacturer's factory, Therefore, from the effective date of the Act, any serviceman with a number of years of practical experience could apply for registration, and, subject to his passing a comparatively simple examination, he would be granted a Registered Radio Servicemen's Certificate without having to serve a further period of apprenticeship.

Condensers:
Members of Conference strongly protested against the monopoly conditions applying to the supply of condensers available to the radio industry. In a resolution to be forwarded to the Minister in charge of Industries and Commerce, it was recommended that the importation of overseas condensers should be allowed, thus providing a better supply at a more competitive price to all consumers.

Supply of Components:
Owing to the dissatisfaction expressed concerning the irregular supply of speakers, the incoming Executive was directed to take suitable action to meet retailers' requirements.

Valves:
In the meantime, it was decided to take no action concerning the importation of old type valves, as it was considered that this matter will rectify itself in due course.

Television:
Satisfaction was expressed with the way in which the Minister's announcement had settled the public's mind concerning the prospects of the early introduction of television to this country. As a result, there has been a material improvement in the sale of radio sets. It was reported by one delegate that a member of his firm had studied the position in Australia, where he found no greater advance than in New Zealand. Neither he, nor the trade, could see any likelihood of television operating in Australia for at least two years.

The Auckland representatives reported on the activities of their Association in this matter, stressing the need for technical training in this subject, and the necessity for maintaining the interest of those technically qualified until such time as TV was introduced into this country.

Sales Tax:
It was decided to approach the Government requesting the elimination of sales tax on radio sets, as has been done with other household goods such as washing machines, refrigerators, etc.

Publicity:
It was resolved that information previously supplied in the Bulletin should now be published monthly in "Radio and Electrical Review," the official organ of the Federation. A quarterly Federation bulletin is to be issued to cover any information considered unsuitable for publication in "Radio and Electrical Review."

Election of Officers:
Officers elected for the coming year are, President (returned unopposed) Mr. N. Souper; Vice-President, Mr. L. D. Hepburn; Executive, Mr. L. Cannons (Wanganui) for North Island minor associations, Mr. A. K. Griffiths (Nelson) for South Island associations; Mr. C. I. W. Archibald was re-appointed Secretary and Mr. Gordon Berry, Auditor. The appointment of representatives to the Radio Interference Committee was left to the discretion of the Executive.

An honorarium of £10 was voted to the President.

Amendment to Federation Rules:
It was decided that the rules of the Federation should be amended to permit the Immediate Past President and the Vice-President to vote at Executive Meetings of the Federation.

Conclusion:
The Conference concluded with expressions of thanks to the President, Mr. N. Souper for his untiring efforts on behalf of the Federation throughout the year, and for his able direction of the Conference.

Around and About

RADIO RESEARCH

In spite of a very restricted budget, Dr. H. A. Whale, research fellow at Auckland University College, is achieving remarkable results in the study of the angle of the arrival of short-wave high frequency signals. This has an important bearing on long-distance radio communications.

Gaining praise from the Commonwealth Telecommunications Board, Dr. Whale's researches have also roused interest in America and Australia, where, as yet, this particular kind of research has not been undertaken, though this is scheduled for early commencement.

With the primary aim to investigate the mode of propagation of radio signals over long distances, this research project, besides measuring directions from which the signals arrive, is measuring the vertical angles of the waves. Results to hand so far have roused much interest here and abroad.

* * *

NEW ZEALAND DOCTORS WATCH TV OPERATION

The teaching facilities offered by television were demonstrated recently in Hamilton before fifty surgeons from all over New Zealand, who watched a thyroid extraction performed by a senior surgeon of the Waikato Hospital staff in another part of the building.

The occasion was the one-day conference of the Royal Australasian College of Surgeons, and this was the first time television had been used for medical demonstration purposes in New Zealand.

The general comment of the majority of doctors was that it was an interesting experiment, far more successful than many had thought possible. The detail was far better than had been expected, and there was no doubt that, in the theatre itself, only two or three could have seen as much as the fifty doctors were able to see on the TV screen. In the opinion of most doctors present, colour television, reproduced on a larger screen would prove an even better medium of teaching. In general, however, they considered that the really intimate details, so essential for perfect training, could be seen far better on the spot, while the atmosphere of the theatre and the general condition of the patient were missed on the TV screen.

* * *

NO MYSTERY ABOUT TELEVISION

Addressing members of No. 1 Squadron, Divisional Signals, in Wellington recently on the principles of television, Mr. J. H. A. Whitehouse, of the television department of Philips Electrical Industries of New Zealand, contended that there is no mystery about television.

"No new electrical principles or elements are involved in television," he said. "What the trained radio technician has to learn is the way in which radio principles (with which he is already conversant) are applied in a television receiver. This, of course, involves special training."

"For the radio engineer to go into television is rather like a person walking into a club, having not been in for a long time, and meeting old friends which he has almost forgotten existed," he continued, mentioning that many long-established principles had been either forgotten or pushed to one side in the ordinary run of radio development.

With the aid of a television receiver, oscilloscopes and signal generators, Mr. Whitehouse provided a practical demonstration of the appearance of signals on the cathode ray tube and of the controlling pulses used to synchronise a television receiver.

Stressing the important role of technical colleges in providing facilities for those wishing to undertake television training, Mr. Whitehouse emphasized that it was essential for trainees to remember that the technical colleges were the only institutions which could provide a nationally accepted certificate of value to the trainee.

Finally, Mr. Whitehouse pointed out the distinct defence value in the art of television, in as much as it teaches "pulse" technique inherent in all radar operations and in certain types of line communication.

* * *

ATTRACTING THE PUBLIC

There is no doubt that, for advertising value, the retailer's window display tops the list. It is the largest space he has working for him both day and night, but are the window display experts always right when they insist, more or less, that the fewer the articles on display, the better the window, all other things being equal. Admittedly, it may be more artistic, but do the public prefer it?

It cannot be denied that, judging by the number of people window gazing, the multiple radio stores which cram their windows full of sets and accessories usually attract more than their share of attention.

Musing on this point, our reporter consulted many members of the public, most of whom confessed to the magnetic qualities of a window full or sets or with hundreds of tools arranged in serried ranks, practically touching each other. It seems that they like to stand outside and have a good look at their prospective purchase first. They like to make sure it is IN the shop, without having to first go in and inquire.

However, that's no reason why such window displays should not be attractive, and there is much to be gained by a frequent change of face, particularly in the case of the smaller store.

For window dressing, an eminent authority tells us that little is needed in the way of tools. Scissors, wire cutters, hammer, staples, tack pullers and such small items as tacks, wire, screw eyes and pins will suffice. Ingenious display stands and features can be contrived very easily, and it will be found that a simple corrugated box covered with crepe paper can be developed into a good display base. Props and aids from the manufacturer can be adapted for special needs.

Essential points to remember are

- Correlate your window display with other forms of advertising.
- Arrange related items in groups.
- Feature prices—it helps sales volume.
- Inspect your work from the outside as you go along.
- Avoid blind spots—make sure that each item stands out from all angles.
- Use empty cartons in place of expensive merchandise where possible.
- Colour and design make window displays more effective.
- A fixed window design, running vertically, is generally severe, displaying a masculine quality.
- A horizontal alignment of display usually suggests relaxation and repose.

Finally, make design and colour count in your window displays, for when you have a window display in which colour, style, design and the merchandise are in harmony, you have a window that will sell.

CHANGE OF ADDRESS

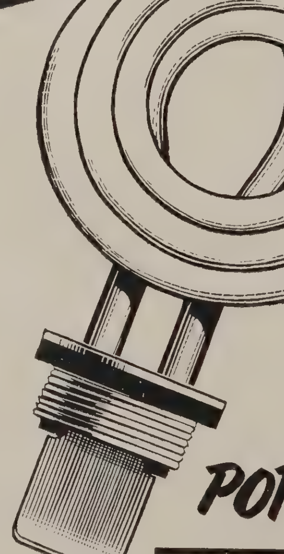
When you change your address, be sure to notify the Subscription Department, "Radio and Electrical Review," P.O. Box 8022, Wellington, New Zealand, and do this at least four weeks in advance. To avoid disappointment through not receiving your copy of "Radio and Electrical Review," should it go to the wrong address through your failure to notify us of a change, we earnestly ask for your co-operation in this important matter.

It pays to stock

- More people ask for EUTRON by name than any other brand. Improved insulation and earthing make EUTRON the safest and most reliable element to recommend.
- Advertised over 11 radio stations throughout New Zealand and sold only through legitimate retailers.

Manufactured by ELECTRIC UTILITIES CO. LTD., 316 Great North Road, Grey Lynn, Auckland, W.2.

(Subsidiary of Nicholson's Holdings Ltd.)



CASH-IN ON EUTRON POPULARITY

Publications Received

"Wireless World Guide to Broadcasting Stations," 7th edition.

A Text Book of Radar, by the Staff of the Radiophysics Lab., C.S.I.R.O., Australia, second edition, edited by E. G. Bowen.

"A.P.A.E. Journal," Vol. 5, Nos. 2 and 3, February and March, 1954.

"N.Z. Electrical Journal," Vol. 27, Nos. 4 and 5, April and May, 1954.

G.E.C. Progress Sheet 53/4, October, 1953. The General Electric Co. Ltd., London, England. (British General Electric Co. Ltd., Wellington).

Osram Bulletin, Vol. 30, No. 4, October, 1953. The General Electric Co. Ltd., London, England. (British General Electric Co. Ltd., Wellington).

The New Zealand Manufacturer, Vol. 5, Nos. 8 and 9, March and April, 1954.

The Gramophone, Vol. XXXI, Nos. 369 and 370, February and March, 1954.

La Radio and TV Revue, Vol. 6, No. 3, March, 1954.

American Exporter, January, 1954.

Wireless Engineer, Vol. 31, No. 4, April, 1954.

Wireless World, Vol. 60, No. 4, April, 1954.

Wireless and Electrical Trader, Vol. 94, Nos. 1224 and 1225.

Enterprise, No. 27, March, 1954. Cory-Wright and Salmon Ltd., Wellington.

G. E. Ham News, Vol. 9, No. 1, January/February, 1954. International General Electric Co., U.S.A. (British General Electrical Co. Ltd., Wellington).

The Radio Constructor, Vol. 7, No. 9, April, 1954.

Break-In, Vol. XXVII, No. 6, June, 1954.

D.S. and I.R. Handbook, 2nd edition, May, 1954.

Radiotronics, Vol. 19, Nos. 1 to 5, January to May, 1954, inclusive. (Amalgamated Wireless Valve Co. Pty. Ltd., Sydney).

Labour and Employment Gazette, Vol. 4, No. 2, May, 1954.

B.I.C.C. Bulletin, No. 11, British Insulated Callender's Cables Ltd., England. (National Electrical and Engineering Co. Ltd., Wellington).

The National Electrical Review, Vol. 2 No. 7, April, 1954. (National Electrical and Engineering Co. Ltd., Wellington).

Mullard TV Outlook, No. 3, March, 1954. (C. and A. Odlin Timber and Hardware Co. Ltd., Wellington).

Westinghouse Engineer, Vol. 14, No. 2, March, 1954. (H. W. Clarke (N.Z.) Ltd., Wellington.

CLASSIFIED ADVERTISEMENTS

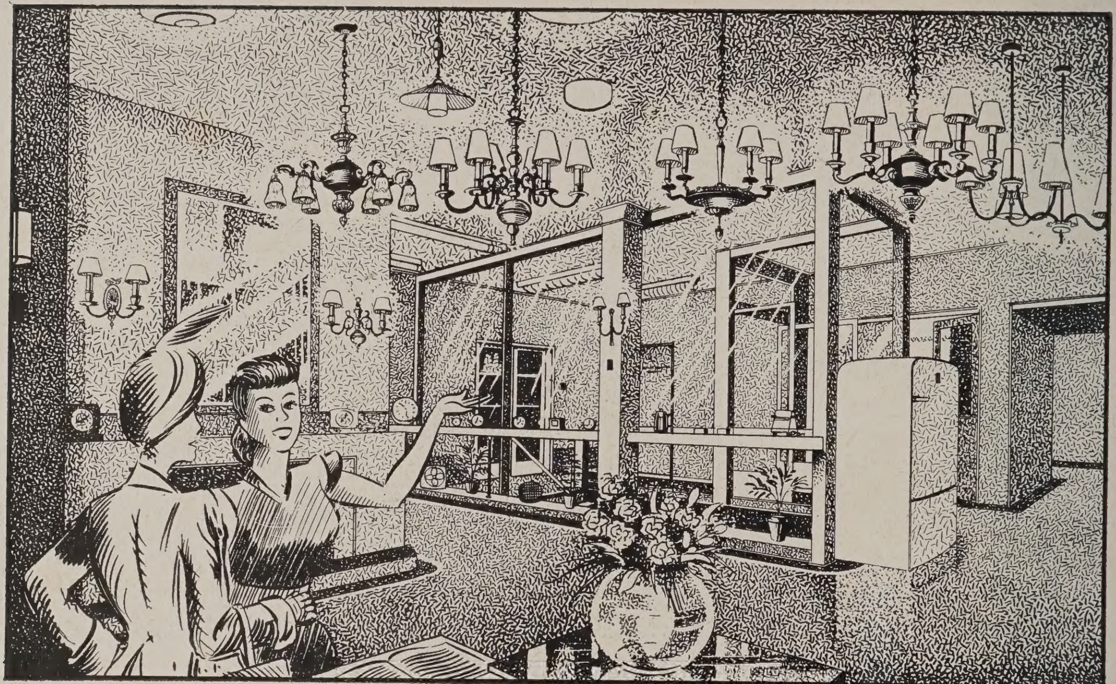
FOR SALE: AC BC348. Propellor Pitch Motor and Selsyns. Offers. Goodger CAA. Shelly Bay.

FOR SALE: One only AVO Valve Tester (large model) practically new and in first class order. Inquiries to Stinsons Radio Department, Suva, Fiji Islands. Stinsons will arrange shipment to any part of New Zealand.

OFFERS WANTED: 57 "Radio and Electronics" Magazines as new. Volume 1, No. 1 to Volume 5 No. 9 inclusive. Replies "Radio," P.O. Box 84, Waipukurau.

FOR SALE: Gilby High-Fidelity Recording Wire .0038 in. dia. one hour spools. Supreme Radio and Recording Service, Victoria Arcade, Hamilton.

BUSINESS FOR SALE. Prosperous Radio Service business in Taranaki, established in 1927. Little opposition. Owner retiring. For particulars, apply R. G. Law, P.O. Box 125, Stratford.



We are Sole New Zealand Agents For—

'SCOTCH BOY'

Magnetic Recording

TAPE

ANOTHER 3M COMPANY PRODUCT

"Scotchboy" perfected dry lubrication does away with blocking and sticking, with wow and flutter. Strong and non-kinking, plastic-backed "Scotchboy" runs smoothly and gives perfect reproduction at all tape speeds.

MAGNETIC DATA:

Coercivity . . . . 240-260 Oersteds
Total Remanent Flux. 0.4/0.5 lines $\frac{1}{4}$ in. width
Uniformity throughout a reel . . . 0.5 d.b.

PLAYING TIMES (per track):

Reels	Spool size	$3\frac{3}{4}$ in./sec.	$7\frac{1}{2}$ in./sec.	15 in./sec.
3280 ft.	$11\frac{1}{2}$ in.	160 min.	80 min.	40 min.
3000 ft.	$11\frac{1}{2}$ in.	150 min.	75 min.	$37\frac{1}{2}$ min.
2400 ft.	$10\frac{1}{2}$ in.	120 min.	60 min.	30 min.
2250 ft.	9 5/16 in.	110 min.	55 min.	27 min.
1200 ft.	7 in.	60 min.	30 min.	15 min.
600 ft.	5 in.	30 min.	15 min.	$7\frac{1}{2}$ min.
300 ft.	$3\frac{5}{8}$ in.	15 min.	$7\frac{1}{2}$ min.	$3\frac{3}{4}$ min.

FREQUENCY RANGE:

50 c/s. to 10 kc/s. at a playing speed of $7\frac{1}{2}$ in./sec.

"Scotchboy's" extra sensitivity and ouptut means you can record either at lower levels for the same output with lower distortion or at the same level for increased undistorted output. Signal/Noise ratio is improved as well.

Manufactured by

MINNESOTA MINING AND MANUFACTURING COMPANY LTD.

167 Strand, London and Slough

TURNBULL and JONES LTD.

Auckland Wellington Christchurch Dunedin Hamilton Palmerston North Invercargill